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WORKS BY SIR B. G. A. MOYNIHAN

Retroperitoneal Hernia. London, 1899
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**The Surgical Treatment of Gastric and Duodenal
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Gall-Stones and their Surgical Treatment
Second Edition, 1905 W. B. Saunders & Co.

Abdominal Operations
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Duodenal Ulcer
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Pathology of the Living and other Essays. W. B.
Saunders Company, 1910

WITH MR. MAYO ROBSON

Diseases of the Stomach. Second Edition, 1905

Diseases of the Pancreas. W. B. Saunders & Co.
1902

ABDOMINAL OPERATIONS

VOLUME I

BY

SIR BERKELEY MOYNIHAN, M.S. (LONDON), F.R.C.S.

LEEDS, ENGLAND

Third Edition, Revised

Fully Illustrated

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TO MY WIFE

PREFACE TO THE THIRD EDITION

THE Second Edition of this work has long been out of print.

For this edition a considerable revision has been necessary, and certain chapters have been entirely rewritten. I have kept strictly to the original purpose of the book, and describe in detail only those operations and methods which are practised by myself. There are certain disadvantages in this course, but I have always felt that what is chiefly needed in medical literature is the direct expression of personal opinions, methods and results.

I am under many obligations. My debt to the surgeons of America is too considerable for repayment; I can only most gratefully acknowledge it. Among those whose work and writings have been a constant help and inspiration to me are Dr. William J. Mayo, Dr. Charles H. Mayo, Dr. John B. Murphy, and Dr. George W. Crile.

My colleagues, Mr. Harold Collinson and Mr. L. R. Braithwaite have helped me in many ways. The final effort to complete the work was made easier by the willing help of Mr. E. Tissington Tatlow.

The illustrations are almost exclusively the work of Miss Ethel M. Wright.

BERKELEY MOYNIHAN.

33 PARK SQUARE, LEEDS
October, 1914

PREFACE

IN this volume I have included only those operations which are common to the two sexes. No gynæcological operations are described.

The surgery of organs, such as the kidney and the bladder, which is partly intraperitoneal and partly extraperitoneal, is not included, nor are the various operations for hernia.

The operations described are those in general use, and all, or almost all, of them are those practised by myself. Some comment will doubtless be made on the fact that there is no detailed reference to any mechanical appliance, button or bobbin, for intestinal anastomosis. This omission is made deliberately, for I believe that the purpose of these mechanical aids has been served, and that their interest is now only historical.

The illustrations are, with few exceptions, original, and have been drawn for me by Miss Ethel M. Wright. I desire to express my thanks to her for her careful and successful work. In preparing the subjects for illustrations, and in the laborious task of reading proofs, I have received great help from Mr. W. Gough, F.R.C.S., and Mr. H. Upcott, F.R.C.S.

I am greatly indebted to my secretary, Miss A. M. Harrold, for help at all stages of the work.

BERKELEY MOYNIHAN.

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ABDOMINAL OPERATIONS.

SECTION I.

GENERAL CONSIDERATIONS.

CHAPTER I.

THE BACTERIOLOGY OF THE STOMACH AND INTESTINES.

MANY of the problems connected with the surgery of the stomach and intestines depend for their elucidation upon a knowledge of the bacteriology of the alimentary canal. This subject is one still in need of further investigation.

Billroth in 1874 was the first to recognise that the intestinal contents of the newborn are always sterile, and that the yellow stools, coming a few hours or days after birth, are the first intestinal discharges to contain micro-organisms. Popoff and others shewed that the appearance of the bacteria in the motions depended upon the time at which the first nourishment was taken. The exact origin of the *Bacillus coli*, which is the constant inhabitant of the intestinal canal in man, has never been satisfactorily determined; but there can be little doubt that the infection takes place through the mouth, and that the vehicle is the food. It is to Escherich that we owe a recognition of the fact that the *Bacillus coli* is the characteristic organism of the human intestine, and that it remains an unvarying inhabitant throughout life.

A bacterial invasion of the intestinal canal is not essential to the life or health of the individual. Experimental work,

which has been amply confirmed, has shewn that life may be sustained in young animals whose food and whose surroundings are sterile. Nuttall and Thierfelder obtained a guinea-pig from its mother by Cæsarean section, and placed it at once in a sterile chamber, supplied with sterile air, and fed it upon sterilized foods. At the end of eight days the animal, which was thriving, was killed, and its intestinal contents found to be sterile. Levin investigated the bacterial conditions in the intestinal canals of animals (bears, seals, reindeer, etc.) in Spitzbergen, and found that, as a rule, the contents of the bowel were sterile. In the Arctic regions, of course, there is a great scarcity of organisms both in the air and in water.

Within the first few hours of life the intestinal contents cease to be sterile; organisms can always be found. Of these organisms, two varieties are described—the permanent and the transient. The permanent variety in man is the *Bacillus coli* and some of the streptococci group; the transient includes any that are introduced into the intestinal canal by the food. It is obvious that, if any organism whatever be introduced deliberately into the stomach with the food, it will remain for a shorter or longer time an inhabitant of the alimentary canal. But, as Gillespie and Miller have shewn, when bacteria are introduced in this way there is a steady decrease in their numbers as digestion proceeds, and in proportion to the increase in the acidity of the gastric contents. According to Miller, at the end of nine hours the stomach contains no organisms. In the duodenum the number of the bacteria is small; but, the further down in the intestine is the material from which the examination is made, the more numerous are the organisms, until the ileocæcal valve is reached. In the large intestine the bacteria are again few in number. Gilbert and Domenici have represented diagrammatically the average bacterial virulence of the alimentary canal of dogs.

Harvey Cushing has investigated the conditions in cases of intestinal fistula. In a case of jejunal fistula a glass of milk

could be entirely recovered within a few minutes of its ingestion, with its bacteriological features practically unchanged. The importance of the physical characters of the food is therefore considerable. If the ingesta be fluid, they are passed rapidly onwards into the duodenum, and are but little, if at all, altered by transit through the stomach. If the food be solid, it will remain, perhaps for hours, in the stomach, subject throughout this time to the action of the gastric juice, and when passed into the duodenum it will have the number

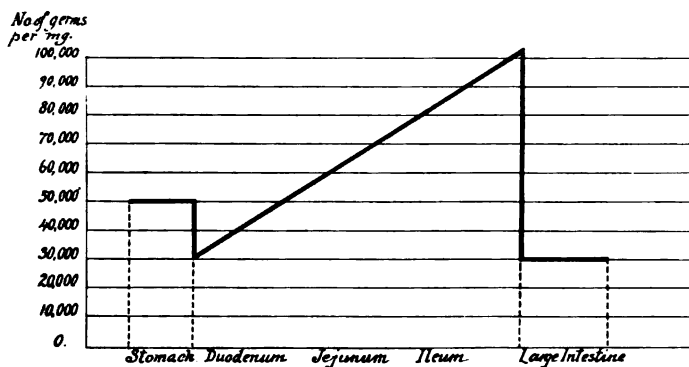


Fig. 1.—"Gilbert and Domenici's diagram shewing the relative number of bacteria present in the contents of different parts of the alimentary tract. The dogs were killed three hours after a meal of bread and meat. Examination of the intestinal contents at this stage of digestion shewed an abundance of organisms in the stomach, a pronounced diminution in number at the duodenum, followed by a gradual rise to the ileocæcal valve, where bacteria flourish in the greatest luxuriance. When the large intestine is reached there is a marked falling off in the number, with a slight rise proportionate to the distance from the cæcum" (Harvey Cushing).

of its bacteria greatly reduced. Macfadyen, quoted by Cushing, has shewn that the bacillus of anthrax, an organism easily killed by the gastric juice, cannot be recovered from the intestine when taken after a full meal, but that when administered with a large amount of liquid on an empty stomach, its recovery from the lower bowel is easy. In one of Cushing's cases, the *Bacillus prodigiosus*, an organism especially susceptible to the action of the gastric juice, could be easily recovered from a jejunal fistula after its ingestion with inoculated milk,

When the normal stomach has emptied itself of food, either fluid or solid, the mucous membrane is sterile; the small amount of material that can be scraped from the mucous surface contains no organisms. Marfan and Bernard have shewn that the same applies to the intestine: that when any part of the intestine has emptied itself of its contents, it becomes amicrobic. In cases of artificial anus in man, the distal loop of the bowel, so long as it remains empty, is always found to be sterile. If from any reason the stomach is unable to empty itself satisfactorily, leaving always some food stagnant, the natural amicrobism can never be attained. Cushing writes: "It is, I believe, dependent only upon interference with the

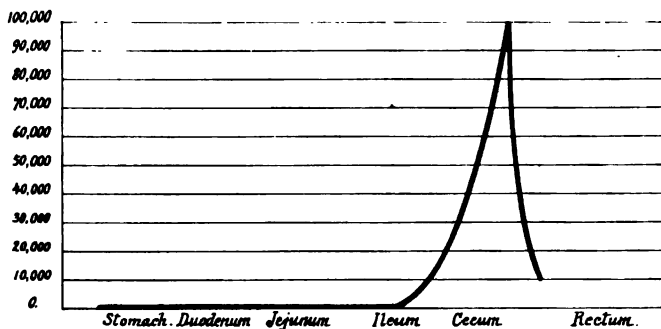


Fig. 2.—Harvey Cushing's diagram shewing the relative number of microorganisms at different levels of a dog's intestine after a prolonged fast.

stomach's power completely to expel its contents that bacterial life may persist in its lumen. The same principle holds true for the duodenum, and it is not improbable that a similar amicrobic state following digestion, with a canal completely free from food and the accompanying bacteria, may be brought about as far down as a condition of emptiness may be reached through fasting." In a dog that had been starved for several days, the upper part of the intestine was found sterile. The accompanying diagram which Cushing gives may be contrasted with that given by Gilbert. It will be seen that all that portion of the intestine which can be rendered empty is by this

means alone rendered sterile also. Conversely in cases of acute or of chronic intestinal obstruction where the bowel has been unable to empty itself for days or for weeks, the intestinal contents are teeming with bacterial life; the *Bacillus coli* and streptococci are often found in great numbers, and their virulence is extreme.

The conclusions which may be stated are as follows:

1. The stomach contains, immediately after a meal, a number of micro-organisms of different varieties, according to the nature of the food administered.
2. If the food is given in a liquid form, it is rapidly passed onwards into the intestine, and the bacterial forms are but slightly, if at all, affected.
3. If food is given in a solid form, it remains longer in the stomach, and the number of bacteria contained therein undergoes a steady diminution until digestion is complete. The empty stomach is then amicrobic.
4. The duodenum is often sterile; the number and virulence of the bacteria of the intestine increase in proportion to the distance from the duodenum, and attain their maximum at the ileocæcal valve.
5. The *Bacillus coli communis* is the characteristic organism of the human intestine; it is never absent after the first few days of life.
6. The stomach and the upper part of the jejunum can be rendered sterile by administering only sterilized foods and by attention to the toilet of the mouth. In dogs, starvation for a few days leaves the upper part of the intestine empty and sterile.
7. The stomach and intestine, when their contents have been discharged and they are empty, are sterile. If the emptying is prevented by obstruction at the pylorus, or in the intestine, the contents, dammed up behind the block, contain organisms whose number and whose virulence are greatly increased.

The importance of these facts from the surgical point of view is that they shew what is to be expected in cases of perforation of the stomach or intestine, and they demonstrate the possibility of rendering sterile, for purposes of operation, the stomach and the upper part of the intestinal canal. For example, when peritonitis results from a perforation high in the intestine, the offending micro-organism is generally a streptococcus; when the perforation is low down in the intestine, the *Bacillus coli* is the most abundant or the only organism.

It is to Dr. Harvey Cushing, of Baltimore, that we are indebted for calling the attention of surgeons to the possibility of rendering the stomach and intestine sterile as a preparatory measure to operations. He wrote, in a very able paper from which I have quoted freely (vol. ix, "Johns Hopkins Hospital Reports"):

"The procedure which we have employed is simple and mainly consists in an attempt to render amicrobic all ingesta. The mouth is rinsed with an antiseptic solution and the teeth are carefully brushed at intervals of a few hours, and with especial care before and after feeding. The stomach, if any chronic catarrh exists and micro-organisms in number are found present after a test-meal, is washed out carefully morning and evening. Food is taken in small amounts and at comparatively frequent intervals, from clean or, preferably, sterile vessels, and consists of boiled water, sterilised milk, beef-tea, albumin-water, and similar liquids. Patients with chronic gastritis have been seen to gain in weight under this régime. Preliminary to the operation for from six to ten hours nothing is given by the mouth, rectal feeding being instituted if necessary."

Many drugs have been given in the hope that by their aid the intestinal contents could be rendered sterile. Among such are β -naphthol, salol, iodoform and actol, to mention only a few. All have proved useless. Recently Adolph Hofmann ("Mitth. a. d. Grenzgebiet.," 1906, Bd. 15, Heft 5, p. 596) has recorded a series of observations made upon the intestinal contents

(recovered from fistulæ, colotomy openings, and enterostomy openings) after the administration of isoform. This drug is administered in powder or in capsules, or in both together, the dose being 3 grammes, given in quantities of $\frac{1}{2}$ gramme, within a period of two to twenty-four hours. The effect was remarkable and constant. The number of colonies that could be cultivated from the discharge was enormously reduced in all cases. The rapidity with which the effect upon the contents was produced depended upon the part of the alimentary canal from which cultures were taken. In cases of pyloric disease the effect upon the stomach contents was noticed in a few minutes, if the drug was administered in powder. Isoform is supplied in powder and in capsules, hardened and unhardened,—the latter dissolve in about an hour and a half in the stomach, setting free the drug; the former pass into the intestine where they are dissolved in a variable and often uncertain time. In the intestine an undoubted effect is produced in thirty hours from the administration of the dose. Though 3 grammes is the usual dose, as much as 7 to 8 grammes have been given to the adult male without producing distress. The symptoms which come from an excessive dose, or from too frequently repeated doses, are loss of appetite, vomiting and a feeling of sickness. Unfortunately isoform is no longer procurable. It is now my general practice before operations which probably involve a resection of the intestine to give large doses of bismuth for several days beforehand. This I began to do in those patients who were to be examined by the *x*-rays, and as I found the method of value I extended it to all cases. One-half ounce of bismuth carbonate is given twice daily for two, three, or four days.

CHAPTER II.

GENERAL REMARKS UPON THE PREPARATIONS NECESSARY IN ABDOMINAL OPERATIONS, UPON THE CONDUCT OF THE OPERATION, AND UPON THE AFTER-TREATMENT OF THE PATIENT.

Success in abdominal surgery, as in all the affairs of life, depends very largely upon the observance of details. In the careful examination of the patient, with reference both to the local and general conditions; in the strict preparation, for a few days before the operation, whenever possible; in neatness, rapidity, and thoughtful planning of the operation—in all these there lie the means and the secret of success. With few exceptions, the same technique is desirable in all operations. I propose to describe the details which are carried out in my own operations, first, with reference to the surgeon, assistants, nurses, instruments, and dressings; and, secondly, with reference to the patient.

PREPARATIONS ADOPTED BY THE SURGEONS AND ASSISTANTS.

It is most desirable—it is even more, it is absolutely necessary—that for the due observance of cleanliness during operations the surgeon should be properly clad. The garments which are suitable for daily wear are surgically unclean and should be changed by all those who are to be in immediate proximity to the area of operation.

The surgeon should be clad from head to foot in spotless sterilised garments. A sterilised cap is worn, so that the heads of the surgeon and his assistant when they meet in sharp contact over the abdominal wound shall not scatter hair and dirt broadcast. A sterile coat is worn, sterile sleeves, and boiled rubber

gloves. Sterilised or, at least, newly washed, white trousers and clean shoes, preferably with rubber soles, are worn. Prepared in this way, the surgeon is safe not to inflict a chance infection in any wound. All parts likely to be near the wound or to touch it are absolutely clean.

Fig. 3.—The surgeon prepared for operation wearing the spectacle mask.

It is not enough, though one can see the practice every day, to wash the hands and perhaps the forearms and to be content with this. When instruments are lying on a towel during the performance of an operation, the surgeon may, in some manipulation, allow an unclean elbow or arm to rest for a few moments upon an instrument, and presently employ

that instrument again. The operator should be so prepared that all his accessible surfaces are clothed with sterile garments. Exactly the same rules apply to the assistants and the nurses. There should be no uncovered surfaces, which, by contact, are likely to cause infection. Experimental work, amply confirmed, has shewn that particles of saliva are ejected during ordinary conversation to a considerable distance.

Fig. 4.—Gauze mask. The gauze is suspended on hooks dependent from a spectacle frame

The saliva contains organisms in profusion. According to one eminent bacteriologist it is in this respect "worse than the worst London sewage." Unless the operator and his assistant, and all those nearly engaged in the operation, can preserve absolute silence during an operation, they should wear gauze masks. I have had a sort of spectacle frame made for me to which the gauze is fixed. The frame is fixed, by bent sides,

behind the ears, so that there is no fear of the gauze slipping or becoming displaced during an operation. It is the custom among the unenlightened to scoff at the necessary precautions taken by those who practise aseptic surgery; the meaning of the word "aseptic" is forgotten. The thoughtful enthusiast may console himself with the reflection that in every race there must be some who lag behind. The laggards, moreover, are generally those who are "quite satisfied with their results;" a testimony not, as it is intended to be, to their results, but rather to the ease of their satisfaction.

Hands.—The preparation of the hands should be the same whether gloves are worn or not. It is almost impossible to over-emphasise the importance of thorough cleansing of the hands and nails. The literature on this one subject alone would require almost a lifetime for the reading, but the conclusions of all investigators are unanimous in stating that an assured and absolute sterilisation of the hands is impossible to obtain. But there can be no question that a sufficiently near approach to perfection can be attained by the exercise of the greatest care. Professor Kocher, for example, whose results are at the least the equal of any, operates sometimes with bare hands. But of the care taken by him to ensure cleanliness, all those who have seen him work, or who have read his book, will realise. It could, I think, be successfully argued that of all the details in the preparation for an operation none equals that of the cleansing of the surgeon's hands.

The preparation begins with a thorough washing in soap and hot water. When the hands and arms are socially clean, a nail-brush or, what is perhaps better, some squares of sterile gauze or butter-muslin may be taken and a thorough scrubbing of the hands, fingers, and nails especially, is begun. Each finger and each nail must be separately scrubbed, and frequent rinsing, in water as hot as can be borne, is necessary. If possible, running water should be used, but, failing that, a series of basins will do equally well. After prolonged washing in

one basin, a second is used, and a third, and finally a fourth. Each basin and the water which it contains should be sterilised. It is of no advantage to have sterile running water if the basin into which it runs is a fixed basin, which cannot be rendered sterile; nor is it possible to have water remain sterile if the basin which it fills is fixed, as in the ordinary lavatory. Either the water must be running continuously and allowed to flow over and away from the hands and arms, or the basin and its contained water must each be easily sterilisable. The washing must be carried out regardless of time. After at least fifteen minutes of soap and water, the hands and nails may be scrubbed with sterile gauze, which is worked into all the crevices and cracks which exist on every hand and finger. After this, some antiseptic application is necessary. The best is alcohol in some form or another. A solution of 60 to 70 per cent. of alcohol to the extent of two or four ounces may be poured over the hands, rubbed well over, and wiped off with a sterile towel, or the hands may be soaked for a few minutes in a solution of spirit and biniodide of mercury. Instead of alcohol a watery solution of biniodide of mercury 1 : 2000 with potassium iodide may be used, and the hands, forearms, and elbows allowed to soak therein for at least five minutes by the clock. Watery solutions have, however, a value far inferior to spirituous solutions, being less effective as germicides and more prone to irritate the skin. The great disadvantage of all antiseptic preparations for the hands is the undoubted tendency that they have to cause roughness. This rough and coarse condition of the skin makes any cleansing very much more tedious and any reasonable sterilisation very difficult of attainment. In these matters the personal idiosyncrasy of the surgeon counts for much. Some operators can bear mercury compounds, others are immune to the irritation of carbolic, but all, so far as I can judge, can bear to use alcohol preparations better than any other antiseptic agent. My own practice is to wash thoroughly in the way I have described, with soap and hot

water, to use gauze friction, to steep for a few minutes in 1 : 2000 biniodide, then to have a wash over with 65 per cent. alcohol, and finally to rinse well in sterile salt solution.

Gloves.—It is now my invariable practice to use rubber gloves during operations. At the first I found some difficulty in working in them, and I felt clumsy and inapt. That was the fault of the gloves, and of my want of knowledge of the proper method of putting them on.

I now use No. 7 or $7\frac{1}{2}$ light or medium rubber gloves. They are a size smaller than my ordinary glove, and therefore fit fairly tight. Gloves may be sterilised in the autoclave or by boiling: they may be used, that is, dry or wet. I greatly prefer the former. There is no difficulty in the dry sterilisation of gloves, though I think the life of a glove is shorter when this method is employed. If used wet, the gloves after being boiled for twenty minutes are put on in the following way: The opening in the glove is held stretched wide by two fingers and the glove is filled, by a movement of "scooping," with sterile salt solution which fills the basin in which the gloves lie. When the glove is nearly filled with water it is held in one hand while the other hand gently wriggles into it. As the hand enters, water escapes until the fingers have reached to within about an inch of the tip. The cuff of the glove is turned backwards and the glove is held from the inside. It is only after the sterile sleeves have been put on that the cuff is turned over on to the forearm. Then the other glove is filled and put on in exactly the same way. The further pulling on of the gloves is impossible, but they may be made to go on by rapidly stroking the glove from the fingers to the wrist with dry sterile gauze. The glove when fully on should fit quite tight, but should not be so tight as to hamper the movements of the hand. The outside of the glove should never be touched with the opposite hand, which, though scrupulously prepared, should be considered, as it doubtless is, capable of infecting the glove if friction be used. (See Kocher's "Operative Surgery," second English edition.)

During an operation the glove-covered hand is rinsed in sterile salt solution as soon as soiled. As a rule, it is easier to work with a glove which is wet than with one which is dry, for when dry, the gloves are apt to stick to instruments, ligatures, and swabs. A frequent rinsing in a sterilised solution is therefore necessary. No antiseptic solution is ever used, and none is permitted to touch the peritoneum. There is abundant experimental evidence to shew that the delicate peritoneum is seriously damaged by contact with antiseptic solutions, and that its power of absorption is thereby decidedly lessened.

During an operation a glove may be pricked or torn by a needle or other sharp instrument. This is more likely to happen when the operator is unused to gloves; as he becomes more accustomed to them and has cultivated a slightly altered tactile sense, he will find that an injury to a glove is rarely caused. If the prick be on a finger, a finger-stall or a finger cut from another glove which has been partially spoilt, must be used to cover the damage. This should be done at once, for if the glove has been worn even for a few minutes, the hand will be septic. The sweat-glands and the deeper portions of the skin will have emptied their organisms on to the surface of the hand. If a rent be made in the hand of the glove, a fresh glove must be put on at once. It is, therefore, always necessary to have a reserve pair of gloves for the surgeon and for his assistant, and several glove-fingers.

At the first using of the gloves the operator will doubtless feel that the fingers are clumsy, and that it is difficult to get a proper grip of any structure. A little practice, however, will soon overcome all these initial difficulties. If a flat gauze swab be used on the gloved hand, it will be found that a better hold is thereby obtained than is possible with the bare hand. A pattern of glove has recently been sold in which the surface of the rubber is roughened by the impress of innumerable fine

pits. In use, however, I have not found any advantage from this.

After the surgeon has become thoroughly accustomed to the wearing of the gloves, he will probably find that he can work quite as well with medium as with thin gloves.

Assistants.—The remarks made as to the preparation of the surgeon apply also to his assistant. As a rule, only one assistant is necessary or desirable. Indeed, many operations—such, for example, as gastro-enterostomy—can be done without any assistance. A good, well-trained assistant is, however, a great help. More assistants than one are rarely, if ever, necessary, and each one is an additional potential source of infection. The fewer persons engaged in an operation, the fewer are the chances of infection. The nurse or nurses immediately engaged in the operation are instructed to prepare in the same manner as the surgeon. A white, sterilised dress or overall is worn, the hair is covered with a sterile cap, and clean, white rubber shoes are worn. If a nurse helps in the operation by handing swabs or sponges, or by cutting ligatures, threading needles, or the like, she should prepare her hands as does the surgeon, and should wear rubber gloves. In these circumstances, she becomes an additional assistant, and if the same nurse be employed over a series of months or years, she will soon become expert in her work and scrupulous in the preparation for it.

Swabs.—Swabs are employed for all operations. I have ceased to use marine sponges for many years; they are more difficult and more tedious to prepare and are not so trustworthy. The large, flat sponge certainly answered its purpose—the protection and covering of the viscera—rather better than any flat swab I have used, but the difference is only slight and is more than compensated for, in my opinion, by the greater sense of security that one has in regard to the sterility of a gauze swab.

Swabs are made entirely of gauze or butter-muslin. I

prefer the latter. The swabs are of various sizes from three inches square to six inches square, and are made by folding over, two or three times, a large square of gauze. The frayed ends of the gauze are tucked in, so that no loose filaments are left on the wound when the swab is used.

The large flat swabs are made of several layers of muslin, and are quilted at the edge in order to prevent fraying. At the corner of each, a piece of tape eighteen inches in length is stitched. The whole of the gauze square can be introduced and the tape left hanging from the wound, a clip being fastened on the end. This method is the most satisfactory of all, for, if no tape be affixed, the sponge or swab must be kept in sight, or a portion of it must project from the wound, and the space in which the surgeon has to work is thereby greatly narrowed.

The small swabs are put up, for sterilising purposes, in packages of two dozen, the large ones in packages of half a dozen. The number of each size is counted at the completion of the operation so as to make certain that none has been left in the abdomen. My own rule is never, under any circumstances, or in any operation, to allow a small swab to be left even for a moment in the cavity; a small swab is not allowed to leave the hand of the surgeon or his assistant; the large swabs are introduced in any number, but a clip is at once applied to each tape, or to a group of two, three, or more tapes. The counting of the swabs under these conditions is not necessary, but it is as well to observe the ceremony, as it impresses upon all concerned the importance of being exact in such matters.

For the last few years I have used in all operations upon the abdomen square sheets consisting of dental rubber with two layers of gauze on each side infolded and stitched round the edges. These mackintoshes are 10 or 12 inches square, and can be boiled or sterilised in the autoclave on a great many occasions. They are used to cover any organ during the time it may have to lie outside the incision, and are used in all gall-bladder operations

to wrap well round the edges of the abdominal incision. Being wrung out of the hot saline solution they serve to keep all the parts they cover warm and moist, and they form an impassable barrier if any infective lesion is being handled. Indeed they are on all occasions and in all places most useful.

Gauze swabs have been occasionally left in the abdomen, owing to a defective method, or an absence of any method, of counting them before and after the operation. As a rule the wound will stubbornly refuse to heal, or having healed will break down, if any foreign material remains. But many cases are known in which an excellent recovery has been made by the patient, and a year or two later a second operation has been undertaken for the removal of an abdominal tumour. A friend of my own, a most careful and competent operator, performed an operation upon the stomach of a girl for a chronic ulcer. A little over a year later the patient again consulted him on account of a painless median abdominal tumour, freely movable and of smooth outline. The abdomen was again opened and a "fibrous tumour" of the omentum removed, which on section proved to be a gauze swab completely invested by the omentum. An interesting case is recorded by Loze ("Rev. de Chir.," 1908, i, 853). A woman underwent an operation for appendicitis; three years later the abdominal cicatrix gave way and 34 strips of gauze were extracted through it, one by one. The operator had not dressed the wound himself but ordered that one strip of gauze should be introduced daily. This was done most conscientiously, and as he had omitted to direct the daily withdrawal of the strip, 34 were introduced but never removed; the wound ultimately healed over them.

The swabs, after being made in the manner described, are packed in a hold-all made of gamgee tissue, protected on the outer side by brown holland. The number in each package is always the same—two dozen of the smaller sizes, half a dozen of the larger size. In these packages the swabs are sterilised, three or four of the hold-alls being wrapped together in a strong,

large towel. The sterilisation is effected in a pressure steriliser, a temperature of 250° F. being maintained for forty to sixty minutes.

It is important that as short an interval as possible should elapse between the sterilisation and the usage of the swabs. The most desirable, though not always the most convenient, arrangement is for the process of sterilisation to conclude within an hour of the operation, and for the packages to be taken from the steriliser forthwith to the operation room. But if this cannot be done, it is most desirable that the interval should not be more than one or, at the most, two days. After a longer period than this it is necessary to repeat the sterilisation. The same rules and procedure apply to the towels used during the operation. There should be an abundance of these, used to cover in the patient completely. These should be sterile, and their sterilisation should have been recently completed.

Instruments and Ligatures.—Everything used by the surgeon or by the nurses engaged in the operation should be sterilised. Bowls, ligature, and instrument dishes, jugs for saline solution, and similar articles should all be boiled. These are often large and even cumbersome in size, and their sterilisation by boiling is not easily effected. I have a large copper vat, measuring two feet by two feet by two feet, into which all bowls necessary for any operation are placed and therein boiled for thirty to forty minutes. If the operation should prove to be a septic one, as in appendix, or tubal, or gall-bladder operations, especial care is subsequently taken that all bowls, etc., are subjected to prolonged boiling. The washing out of such basins with strong antiseptic solutions may be soothing to the conscience of the surgeon or of the nurse, but it probably does not much affect the power of procreation of a pyogenic organism. Prolonged boiling is necessary.

Catgut.—During the last nine years I have used exclusively the method of Claudius in the preparation of catgut.

The ordinary raw commercial catgut is steeped in a solution made by adding one ounce of iodine and one ounce and a half of potassium iodide to five pints of water, for eight to ten days. The crystals of potassium iodide and of iodine are together dissolved in about two and a half ounces of water, first, and the solution is then diluted to the requisite degree. The catgut may be kept in this solution for many weeks without undergoing any change for the worse. It can be used on the eighth day or on any subsequent day. I have tested this catgut thoroughly and am convinced, on experimental and clinical grounds, of its sterility. The instruction given by Claudius and all subsequent writers is to use one ounce of iodine and one ounce of potassium iodide; but with these proportions the full solution of the iodine is impossible. Moschowitz's modification of the Claudius method consists of placing ordinary raw commercial catgut for five days in a 5 per cent. alcoholic solution of iodine, then removing and storing dry. Catgut prepared in this way may be soaked in sterile water before use. I have tried this method but find that the results are inferior to those obtained by the original Claudius method—the catgut being too brittle.

Catgut is used for almost all ligatures. If anything stronger is needed, then Pagenstecher's celluloid thread is used. This is made in several sizes, but the thin and a medium size are all that are necessary. I use this material for all ligatures or sutures that require to be retained in place for more than a few days. The use of silk has been entirely abandoned by me for some years, as I find that the celluloid thread is more easily sterilised, that it presents a smoother surface, and that it is far stronger than an equal size of silk. The breaking of a Pagenstecher thread ligature or suture is an extremely rare occurrence; when it happens, it is almost certainly due to the fact that the thread has been boiled too often. The thread when wound on glass reels can be boiled for four or five operations, but after this it begins to fray and is then liable to break. It is, moreover, then most unsuitable for sutures, for the rough surface tears

the peritoneum as it is being pulled through. This is the only fault that the thread has, and as the thread is very cheap, it is better to throw it away, after being boiled three or four times, than to run any risk of its breaking.

Drainage Material.—During recent years a marked change has come over surgical opinion with regard to the question of drainage after abdominal section. At one time it was considered that drainage was the safeguard after all operations; that the provision for the free escape of inflammatory products made up for any slight fault in the operative technique. Now, thanks largely to the work of Clark and others who have studied the question with great care, we know that, when employed as a routine measure, drainage is rather a means of sepsis than a measure of escape from its effects. Drainage of the peritoneal cavity is very rarely necessary. The point will be dealt with again when we come to speak of the various operations; but, speaking generally, one may say that it is only for septic conditions that drainage is ever needed.

Gauze, which is so often used as a “drain,” is the worst material possible for such a purpose. Gauze is not a drain, it is a plug. It may with advantage be used when it is wished to set up a barrier shutting off a part, possibly infected, from the general peritoneal cavity, which remains unsoiled. The rapidity with which the omentum especially, and in less degree the intestines, adhere to gauze is remarkable. Probably within two or three hours any area surrounded by a few layers of gauze is thoroughly isolated from the rest of the body cavity. There are cases, too, in which an oozing surface may need to be submitted to pressure to check or arrest the hæmorrhage; and for this purpose also gauze is more useful than anything else. But as a drainage material it is of very little value. For within a few hours its meshes are filled in with lymph, no liquid can be absorbed or transmitted by it, and any serous or other fluid which may collect is very probably pent up, quite unable to escape with any freedom. On

the removal of such a strip or roll of gauze a gush of fluid is often seen to escape. If a little drain is required, as some sutures are required, for purely "hypnotic" purposes (so that the surgeon may sleep better at night), then a fine strip of dental rubber tissue will be found the best material of all.

In cases where a larger drainage is necessary the split rubber tube may be used. This tube may be of any size up to a diameter of one inch. The tube is cut of adequate length and slit up with scissors; the terminal portion is cut slant-wise in order to give a wide inlet for the fluid to be drained through to the lumen of the tube.

PREPARATION OF THE PATIENT.

In all cases an adequate preparation of the patient is most necessary. There are certain surgical emergencies, catastrophes like the perforation of a gastric or a duodenal ulcer or the rupture of a tubal gestation, in which the urgency of affairs does not permit of any elaborate detail to be observed. But, whenever time and circumstance and opportunity render it possible, the preparation of the patient, both locally and generally, should be most scrupulously observed. It is said by some surgeons that strict preparations are absurd, but there can be no question that they repay one in better results. The patient should be kept in bed for the whole of the day preceding operation, and for the afternoon and evening of the day before that. If the operation is to be done on, say, Wednesday morning, the patient goes to bed on Monday afternoon. He is at once given five grains of calomel or any other aperient he prefers, which is followed early on Tuesday morning by a full dose of saline aperient. Later in the morning if these have not acted, an enema of soap and water is given, and if the bowels are at all loaded, or the patient has previously suffered from constipation, the enema is repeated late at night. The condition of the mouth receives close attention. Every patient is given

a new tooth-brush and a bottle of antiseptic mouth-wash on arrival in the Nursing Home or hospital, and the nurse is instructed to see that a thorough cleansing of the mouth is observed every hour or two during the day. It is astonishing to what a degree of uncleanness even the better class of people will allow their teeth to go. Patients with gastric ulcer and its complications seem to suffer especially from bad teeth, indeed it has been asserted by many that oral sepsis is *the* important factor in the causation of gastric ulcer. If the patient is in very feeble health, the nurse is instructed to clean the patient's mouth by frequent wiping with gauze or lint, and the patient subsequently rinses the mouth out. It is possible, as the excellent work of Dr. Harvey Cushing has shown, by careful attention to the condition of the mouth, and by the sterilisation of all foods, to render the alimentary canal comparatively aseptic. All patients from the moment they are received into hospital are fed on fluid diet, and everything given is sterilised, and the feeder or vessel from which the food is taken is also boiled.

I am disposed to think that the occurrence of parotitis and perhaps of pneumonia after abdominal operations is largely due to infection from the mouth. In some cases so foul a condition of teeth and gums may be accidentally discovered as to make a little delay in operating imperative. In one patient I found, quite by accident, a degree of suppuration in the mouth and a foetor of breath that warranted a diagnosis of Riggs's disease. In such a case, and even in bad cases of carious teeth, an aspiration pneumonia is not unlikely to occur, or an extension of inflammation along Stenson's duct, unless a thorough and repeated cleansing is observed.

The skin of the abdomen needs, and must receive, very careful preparation twenty-four hours before the operation. The hair is first shaved away from the whole abdominal wall and from the pubes. It is evidence of careless work to see only a patch

shaved, one-half of the pubic hair, for instance, remaining untouched. It is well to limit the operative field, of course, but the preparation of the skin must extend widely beyond it.

A free washing with soap, and hot water frequently changed, is first necessary. The best material wherewith to wash is sterile gauze in large pads. These are moistened with hot water and rubbed with soap till a good lather is obtained. This washing should be continued for a quarter of an hour, the water and the gauze being frequently changed. An antiseptic compress is then applied and left on until immediately before the operation. The compress consists of lint of two or three thicknesses, soaked in 1 per cent. formalin, 1 in 80 carbolic, or 1 in 2000 biniodide lotion. I prefer the former in the belief that there is by its means a deeper penetration of the skin and of the glands. Upon the operation table the skin is again washed with spirit soap and biniodide lotion, dried, and wiped over freely with a solution of spirit (70 per cent.) and biniodide of mercury (1 in 1000). This is then dried away, and Harrington's solution is applied and is allowed to remain for two minutes, when it is wiped off with a swab wet in spirit solution. No preparation will sterilise a skin so effectually as Harrington's solution, whose composition is as follows:

Commercial alcohol	640 c.c.
Hydrochloric acid, pure	60 c.c.
Perchloride of mercury . . . . .	.8 gramme
Water	300 c.c.

The skin though thoroughly prepared is always covered as soon as an incision is made. This I do with "tetra" cloths held to the wound edge by the special forceps I designed for the purpose, which are depicted in Fig. 5.

It is supremely important that the skin should not be roughened or chapped and that no irritative rash should be caused. Overpreparation to the extent of damaging the skin is almost as bad as no preparation at all. If there are any small furuncles or septic cracks on the skin

within the operation area, these must be carefully disinfected. The only satisfactory method of doing so is by means of the actual cautery, the point of the hot metal being kept in contact with the infected spot until all the septic matter is destroyed. When it is realised that the yellow spot in a furuncle may contain a pure culture of the *Staphylococcus pyogenes aureus*, the complete annihilation of such a colony is seen to be a desirable thing.

If the skin of the patient should be very rough, scaly, chapped, or cracked, its adequate preparation is almost impossible. In these conditions, the "rubber dam" introduced by

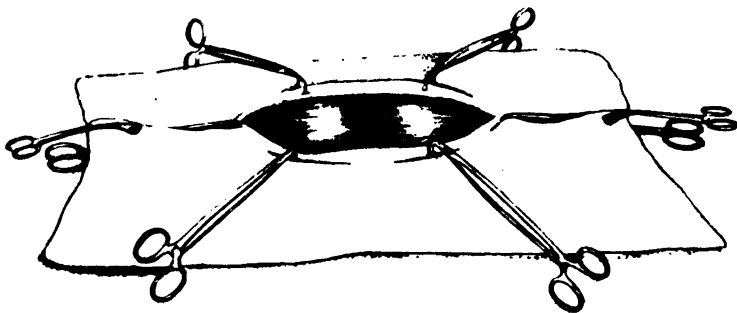


Fig. 5.—Tetra cloths held in position by special forceps.

Dr. J. B. Murphy, of Chicago, will be found of the greatest service. It consists of a strong, very adhesive material which is stretched and then placed on the abdominal wall, to which it clings most closely, becoming, in fact, for the time, an inseparable part of this wall.

Through it the incision is made, and the hand lying outside, or any viscus escaping from the abdomen, lies, not upon the abdominal wall, but upon this sterile rubber dam.

As a general rule, no more preparations than those indicated are necessary, but in some few the general con-

dition of the patient may be so enfeebled that special precautions are needed. It is a matter of the highest importance in all cases to ensure that the heart and the kidneys are acting well. Inefficient kidneys are among the most serious obstacles to success in any major operations, but especially in any abdominal operations. A routine and most exact examination of the urine for two or three days is therefore necessary. If the patient be feeble, or the heart so weak as to be a cause of anxiety, much good may be done by hypodermic injections of strychnine and digitaline for a few days before the operation. Five minims of the liquor strychninæ may be given three or four times daily. If the patient has been accustomed to alcohol, his usual quantity may be allowed him. All patients who are submitted to any abdominal operations are clothed in a suit of gamgee pajamas made for them by the nurse. After being made, of appropriate size, the suit is well warmed and is put on a few hours before the beginning of the operation. It is worn until all risk from the operation is past, and is then removed limb by limb. It is most important that all patients should be warmly clad in this way before, during, and after the operation.

OPERATION.

The operation, if possible, should be performed in a room specially furnished for the purpose. In a public hospital a well-equipped operation theatre is always provided. In a nursing home or in a private house it is sometimes necessary to operate in the patient's bedroom. The advantage of this is that it is less of an ordeal to the patient, who is sometimes alarmed at the prospect of being taken to a special room, and that there is less of lifting or of carrying after the operation. These trivial advantages are, however, greatly outweighed by the disadvantages, which are, that in the conversion of a bedroom

into a theatre there is much traffic, many tables, instruments, etc., having to be taken into the room; that it is not possible to have all the needed appliances to hand with the same certainty, and that, finally, the smell of the anæsthetic clings to the room for many hours. An ordinary room in a nursing home can readily be converted into, and equipped as, an operation room to the great convenience of the surgeon. Such a room should be cleaned

Fig. 6.—Crile's method of anoci-association. The skin (not the subcutaneous tissue) is injected with a solution of novocaine 1:400.

thoroughly and disinfected by formalin vapour at frequent intervals, and always after any septic operation. The operation table should have the foot towards the light, and should be of good height. Many of the tables are about three inches too low. If the table is high, it is more convenient and more comfortable for the surgeon, and if, for any brief manipulation, it is necessary for the

surgeon to be at a rather high level, a plain metal or wooden footstool can be used.

The preparations for the operation must all be completed before the anæsthetic is administered, so as to ensure that the patient is not kept under any longer than is absolutely necessary. The choice of the anæsthetic is no longer left to the administrator thereof, but the procedure which Crile has advocated for the production of the shockless operation by **anoci-**

Fig. 7.—The anterior sheath of the rectus muscle is infiltrated with novocaine.

association is the one I now adopt. The investigations of Crile have shown that while inhalation anæsthesia prevents the *feeling* of pain, it does not prevent the nerve impulses set up by a surgical operation from reaching the brain. These impulses cause exhaustion of the brain cells, and result in shock of a lesser or greater degree of severity.

On the other hand, local anæsthesia, although it may block the nerve impulses originated by the surgeon's manipulations,

cannot prevent the destructive psychic strain from which patients operated upon under a local anæsthetic must suffer. In order therefore to obtain true anoci-association both a local and a general anæsthetic must be employed.

The anæsthetic technique for abdominal operations consists of a preliminary injection of one-sixth of a grain of morphine and one-hundredth of a grain of scopolamine and one one-hundred-and-twentieth of a grain of atropine about half an hour before

Fig. 8 The peritoneum is opened, the edges seized with long clips, and everted. A solution of quinine and urea hydrochloride (1 in 150 or 200) is injected from within.

the actual commencement of the operation. This quiets the patient and prevents excessive anxiety. Inhalation anæsthesia is induced in the ordinary way with nitrous oxide gas followed by ether. As soon as the patient is unconscious and the transverse scratching of the skin made, to which I shall refer later, the line of incision is infiltrated with 1 in 500 solution of novocaine, taking care to make the injection into the skin itself, and not

beneath it. The accurate attainment of this intradermal injection is signified by a white "pig skin" appearance along the injection line.

Incision through this anæsthetised area exposes the rectus sheath, which is in turn injected somewhat widely, submitted to pressure to diffuse the solution, and then incised. The rectus muscle next receives a few injections. The peritoneum is now anæsthetised by passing the needle between the trans-

.

Fig 9.—The infiltration of the peritoneum is carried throughout the suture length of the incision and to a distance of $1\frac{1}{2}$ in. from the cut edge.

versalis fascia and the peritoneum itself. A pause is made while all bleeding points are ligatured. This pause should be sufficient to ensure complete blockage with the novocaine. The peritoneum is now raised gently with forceps and incised for about 1". The incised area is now infiltrated on the abdominal aspect and the incision then prolonged; the peritoneum being raised gently with forceps and each newly incised portion re-infiltrated over an area reaching 2" beyond the wound edge in every direc-

tion. The solution used for this peritoneal injection is a $\frac{3}{4}$ per cent. solution of quinine and urea hydrochloride. If the injection has been successful a blister will be raised on the peritoneum at the site of each puncture. Pressure with the finger on these blisters ensures adequate absorption of the anæsthetic. If the blocking has been complete it will be found that with a very light degree of ether anæsthesia there is no rise of intra-abdominal pressure, no tendency to expulsion of the intestines and no muscular rigidity. Before closing the abdomen the injections of quinine and urea into the peritoneum are repeated.

Fig. 10.—The skin is closed by deep sutures which take all the layers of the abdominal wall, except the peritoneum, which is closed by a continuous catgut suture.

The punctures made by the skin tension sutures should be injected with novocaine.

If malignant disease and acute infective conditions are excluded infiltration of the meso-appendix, of the base of the gall-bladder, of the uterus and the broad ligaments, the round ligaments, mesentery, or any portion of parietal peritoneum can be carried out. Novocaine is used for all the extraperitoneal injections; quinine and urea for the intraperitoneal. As much as 6 ounces of quinine and urea ($\frac{1}{2}$ to $\frac{3}{4}$ per cent.) may be used without danger.

The anæsthesia produced in this way lasts for about five days, especially if the quinine and urea injections into the peritoneum are repeated before closing the abdomen. In addition to minimising, or possibly entirely preventing, post-operative shock, it also lessens pain and necessitates the administration of a smaller quantity of inhalation anæsthetic. The post-operative rise of temperature with acceleration of the pulse and also the

.

Fig. 11.—The stitch punctures are injected with a solution of quinine and urea hydrochloride.

abdominal distension and nausea, are very considerably minimised.

A slight objection to this procedure is the tissue oedema which lasts for some time even after the healing of the wound.

A competent assistant; a nurse to look after instruments, ligatures, etc. (this can be done by the surgeon himself if he so wishes); and a nurse who is to change bowls of saline solution, and generally fetch and carry, are all the

staff necessary for any operation. The nurse who carries basins, etc., should be told to keep her hands away from contact with anything which is afterwards to be handled by the operator or assistants. Her hands, for example, should be outside a basin she is carrying; the thumbs should not be, as they often are, inside the edges of any vessel.

The abdominal incision is made in accordance with the principles mentioned elsewhere. Before beginning the ab-

Fig. 12. —The right way and the wrong way to carry a basin.

dominal incision a few light transverse scratches are made with a needle, at distances of about one inch. The object of this is to afford a guide for the introduction of the deep stitches at the completion of the operation. Each scratch on one side exactly meets its fellow on the other, and a mathematical accuracy of apposition results. The great majority of the infections during the conduct of an operation come from the patient's skin. No method of skin preparation yet devised will ensure that the skin remains sterile for more than, say, half an hour. At the end of

that time, indeed as a rule long before, organisms have been sweated up from the depths of the skin, and are ready to cause infection. The skin, therefore, even after thorough preparation, is kept entirely out of the operation field. This is best done by applying tetra cloths over the edges of the wound and fixing them there by means of the special forceps which I introduced for this purpose several years ago. By this means no hand nor any viscus need come into contact with uncovered skin from the beginning of the operation to the end. When the tetra cloths are removed upon the closure of the first layer of the wound a swab wet with spirit and biniodide lotion is used vigorously to wipe each side of the incision before any deep sutures are passed.

As soon as the abdomen is opened, a complete, or at least an adequate, examination of all the parts concerned must be made. It is so easy to omit noticing points which are vital to the success of an operation. For example, an hour-glass stomach may well be overlooked; many such cases are recorded, owing to the fact that a dilated pyloric pouch has been mistaken for the whole organ. A single stricture of the intestine has been operated upon, when multiple strictures were present; and so with wounds of the intestine,—one has been sutured, another left undiscovered. The appendix has been removed and a growth in the intestine left unrecognized. A gall-stone has been removed from the gall-bladder, and another left in the common duct. And so the list might be increased. A few minutes spent in painstaking examination of all the parts affected, or likely so to be, is well repaid in better results.

The lesion having been disclosed, the area to be operated upon is isolated. This should be done in a routine manner. In "packing off" the abdominal cavity from the parts immediately concerned, I use sterile gauze swabs of large size, well packed into position, so as to completely surround the field of operation. They remain unchanged throughout the operation.

Each swab has a long gauze tape upon it, and to each tape a clip is fastened. On the inner side of this outer barrier of large swabs as many mackintosh cloths are placed, as are necessary completely to isolate the area of manipulation, both from the outer layer of large flat swabs, and from the wound edges; these are changed as soon as soiled. This method of having a double protection is, I feel sure, the most satisfactory of all, and is the most efficient in preventing any soiling of the parts. It is important, too, to remember that the wound edges require protection just as much as the general peritoneal cavity and the viscera. The pus from an infected gall-bladder, or the fæcal matter from the intestine, if brought into even the slightest contact with the abdominal wall will result in a suppuration of the wound, and not improbably in a weakened scar and a ventral hernia. The swabs must therefore be made to ensure protection for the wound edges, or better still, the mackintosh cloths which I have mentioned may be carefully folded over all wound edges so that all parts of them are invisible. The most dainty care should be exercised all the time. A very effective method of preventing soiling in septic cases is to smear the fascial and muscular layers of the abdominal wall with hot sterile vaseline containing 1 per cent. of formalin. This forms an efficient coating for the tissues, preventing the penetration of septic material and lessening the area of subsequent suppuration.

The swabs when introduced must be wrung out of hot sterile salt solution (temperature about 105°-110° F.).

Instruments when boiled may be kept in a flat dish containing hot weak carbolic lotion, or may be spread out upon a dry sterilised towel; preferably the latter, for all operative work should be kept as dry as possible.

The operation should be conducted as speedily as is consistent with careful and complete work. An operator should always be speedy, never hasty. Speed should be the achievement, not the aim, of the operator.

THE TREATMENT OF ADHESIONS.

Adhesions are frequently encountered in all abdominal operations. They are, of course, the result of inflammatory conditions, sometimes recent, sometimes long past. The operation may be called for by conditions which are due directly and solely to the adhesions, or the adhesions may be a mere incident in the operation which is primarily directed to the removal of a different condition.

The question that arises is as to the manner in which such adhesions should be dealt with,—are they to be separated always; may they be ignored sometimes; or, after separation, shall something be done to substitute for one viscus another whose adhesion would be relatively unimportant?

When adhesions are encountered in a case of gastric ulcer it is almost always desirable to separate them. If, for example, an ulcer be attached by a stalk of adhesion to the under surface of the liver, the adhesion should be cut through, and probably the ulcer be removed. Such adhesions to the liver or the diaphragm may be, and not seldom are, a cause of great distress, of pains which radiate to the chest or elsewhere. A constantly moving organ like the stomach cannot well brook interference. An anchoring of its walls to one spot is often the cause of much suffering. When such adhesions are separated, conditions remain behind which may set up fresh plastic peritonitis and new adhesions result. Even if such new adhesions form, it is probable that they will be less crippling than the old ones. But, in order to prevent their formation between the stomach and a fixed point, such as the liver or the diaphragm, the omentum may be folded over the bare or roughened area.

If adhesions around the gall-bladder are present when it is necessary to perform the operation of choledochotomy, the propriety of ignoring or of dealing with adhesions depends upon a variety of circumstances. If the patient be old, or feeble, or ill suited to long surgical manipulations, it is best to ignore the

adhesions altogether and to perform the manoeuvre of "rotation of the common duct" described elsewhere. Adhesions around the gall-bladder in a case of this kind are often very dense, exceedingly complex, and may involve the colon, which tears not unreadily if roughly handled. The gall-bladder in such a case has undergone sclerosis, and if stones be within it, they are of no great consequence. They have undergone, very often, what Mr. Rutherford Morison calls "the natural cure" and may safely be left undisturbed. These remarks only apply to the aged and enfeebled. In young, or middle-aged and healthy people, it is better to separate the adhesions, and, in addition, to perform cholecystotomy or cholecystectomy, as may seem best.

With regard to adhesions around the appendix, it is proper always to separate them and to remove the appendix. With the cause removed, adhesions, even if they re-form here, do not come in such denseness as before, and are probably only transient. I have certainly seen them disappear when the abdomen came to be examined later.

Adhesions are often said to result from surgical manipulations within the abdomen. If they do, I believe they are due to one of two chief causes,—roughness in manipulation (that is, traumatism) or sepsis. In cases of carcinoma of the stomach when a preliminary gastro-enterostomy is performed, the abdomen is reopened in a couple of weeks for the purpose of performing partial gastrectomy. In such cases I have not seen adhesions of any kind. The amount of handling that is necessary for most operations can be borne by the peritoneum without any inflammatory response.

Dr. E. Wyllys Andrews has introduced an operation which he describes as "colohepatopexy or colon substitution." He considers that adhesions around the gall-bladder are unavoidable after operations thereon, and points out that such adhesions are only serious when they involve the stomach or the

beginning of the duodenum. When the colon is implicated, there are no symptoms. His technique is:

1. A free incision, avoiding old scar.
2. Careful inspection of the position and the mobility of the stomach and separation of adhesions.
3. The transverse colon and the omentum are pulled up and thrust into the space between the pylorus and the liver. This new relation is maintained by suturing the colon and omentum to the gastro-hepatic ligament.

He draws the following conclusions:

1. Gall-tract adhesions are inevitable after disease and operations.
2. They are beneficent, harmless, and symptomless in all but a few cases.
3. These few represent malposition rather than trouble from adhesions, *per se*.
4. The colon, gall-bladder, duodenum and pylorus can adhere to each other without impairing their function. The other parts of the stomach cause trouble if involved.
5. Such adhesions will re-form when separated unless the colon is substituted for the stomach.
6. The causing of colon adhesions to the liver does not disturb the function perceptibly.
7. Certain vague gastric disturbances have probably been treated by gastro-enterostomy when the patients would have had more benefit from this operation.

I have long held the view that the falciform ligament offered great help to the surgeon in these cases. It can be attached to the omentum close to the hepatic flexure in such manner as to form a veil or curtain separating the gall-bladder or its fossa, when cholecystectomy has been done, from the duodenum or stomach, and so preventing the formation of crippling adhesions.

When adhesions are encountered they should be separated

with great gentleness. This is best done by "wiping" them away with a piece of sterile gauze. Traction should always be avoided as much as possible, for it is productive of muscular spasm during the operation and of shock subsequently. Shock is very often the response on the patient's part to manipulations which would have been recognised as productive of severe pain if the operation had been performed without an anæsthetic.

If the omentum has been separated and a rough edge or a ligatured stump remains, this may be rolled in upon the omentum itself which is closed over by a stitch. This ensures that only smooth surfaces present on the outside.

DRAINAGE AFTER ABDOMINAL OPERATIONS.

The use of drainage in abdominal surgery has been frequently and fully discussed, and has attracted the attention of many laboratory workers. Opinion as to its worth has veered from one direction to another, almost at the caprice of fashion. At one time it was customary to drain after many of the simplest operations, if a few adhesions had been separated, or even the slightest damage inflicted upon the peritoneum. Lawson Tait, whose emphatic pronouncements rightly carried great weight, wrote, "When in doubt, drain." Doubt, in those early days, was the prevailing mental attitude and the result was, for a time, the almost constant employment of a tube. When a case "went wrong" if no drain had been introduced, the act of omission was held responsible for the disaster. The principles which underlie the use of drainage are now better understood, with the result that drainage of the abdomen has very largely fallen into disuse. When a drain is introduced into the abdomen, whether gauze or a tube be used, certain results are constantly observed. There is, for twelve to twenty-four hours, a fairly profuse discharge of a serous, perhaps slightly turbid, or blood-stained fluid. After this time, the quantity gradually lessens and the drain is then generally removed. If the drain, however, be kept in, suppuration follows, the result of an in-

evitable infection. Since a general infection of the peritoneal cavity does not occur, it is clear that the pus comes only from the lining membrane of the track. It has been shewn by experimental work that the drainage material, whatever its nature, acts as an irritant. It is at once surrounded by the intestines and omentum from which a serous exudate occurs, and a local hyperæmia is observed. Yates describes the changes thus: "As the inflammatory reaction increases a fibrinous exudate is formed and there is more intense local congestion and some œdema. The serosa loses its lustre and is finally covered with opaque plastic fibrin. This fibrinous surface persists in the presence of smooth drains for at least seven days. Gauze, however, acts differently. The fibrin becomes incorporated in its meshes, followed by an ingrowth of granular tissue, so that, when the gauze is removed, instead of leaving a smooth, yellowish surface, it is rough and bleeding, with fibrin and superficial tags of granulation tissue still clinging to the more superficial portion of the gauze."

If the track left be examined after a gauze drain has been removed, some fine filaments of the cotton fibre are found. Infection of the canal filled by the drain is unfailing; it may be due to organisms escaping from the intestine, or to others which travel downwards from the skin. The organism most constantly found is the staphylococcus albus. Clark found, at autopsy, that infected pockets occasionally were found close to the drain track, and also that the organisms causing the peritonitis might persist in the drain track after they had disappeared from the general peritoneal cavity.

If, in dogs, a drain be introduced into the general peritoneal cavity and in eighteen or twenty-four hours a coloured solution be injected through a needle passed into the peritoneum just below the ensiform cartilage, none of the fluid passes out at the site of the drain, even when the general cavity is filled to its utmost capacity. A tube, it is clear, does not drain the general peritoneal cavity at all after this lapse of time. If during

an operation for, say, general peritonitis due to appendicitis, tubes be placed in both the iliac fossæ, and another through a median incision into the pouch of Douglas, a stream of salt solution introduced into the general peritoneum will flow from all the openings. Temporary drainage of the peritoneum is therefore clearly possible. Experience shews, however, that all drain materials are speedily isolated and cease then to do more than drain the cavity which they themselves have produced.

Prolonged drainage of the general peritoneal cavity is a physical impossibility. The tube or wick of gauze is almost immediately isolated and it is not long before it is encapsulated. It provokes a copious thin discharge from the serous surfaces which surround it, forming, as Yates terms it, "a potential cavity which is speedily converted into an actual cavity" by the action of a plastic fibrinous exudate, forming encapsulating adhesions. Yates, after a very comprehensive discussion of the whole question, comes to the following conclusions:

Drainage of the general peritoneal cavity is physically and physiologically impossible.

The relative encapsulation of the drain is immediate.

The absolute encapsulation occurs early (less than six hours in dogs) and can be retarded but not prevented.

The serous external discharge is an exudate due to the irritation of contiguous peritoneum by the drain.

There is a similar inward current from the potential into the general cavity.

This external exudate diminishes remarkably with the formation of encapsulating adhesions.

These adhesions, under approximately normal conditions, form about any foreign body.

Their extent and density depend on the degree and the duration of the irritation of this body.

Primarily fibrinous, these adhesions become organised in a few days (three days in dogs).

If the irritation persists, they become progressively more mature fibrous tissue.

After irritation ceases, their disappearance depends princi-

pally upon a mechanical factor,—the ability of the involved surfaces to pull themselves or to be pulled loose.

Drains should be the least irritating, and should be gradually and finally removed as soon as possible.

Irrigation through drains is futile to prevent adhesions, and dangerous.

After a drain is inserted, all intra-abdominal movements should be reduced to a minimum.

As soon as the drain is removed, intra-abdominal activity should be stimulated, to aid in the disappearance of the remaining adhesions.

Peritonitis, if not too severe, possibly aids in the rapidity of the encapsulation of the drain.

A drain in the presence of infection is deleterious to peritoneal resistance, and should only be introduced to exclude more malign influences.

Postural methods, unless destined to facilitate encapsulation, are both futile and harmful, as far as drainage is concerned.

Peritoneal drainage must be local, and unless there is something to be gained by rendering an area extraperitoneal, or by making from such an area a safe path of least resistance leading outside the body, there is, aside from hemostasis, no justification for its use.

It is therefore clear that the use of gauze or rubber protective, or tubes of any sort left in the abdominal wound, should be restricted to those cases where it is necessary to exercise pressure to arrest bleeding; or to isolate a part of the peritoneum when a known infection has occurred; or when the escape of a fluid along a track isolated from the peritoneum is anticipated (as in choledochotomy); or for temporary drainage of the general peritoneal cavity. The length of time during which drainage of the general peritoneum is possible has not been accurately reckoned, but it is almost certainly very brief, probably not more than twelve hours as a maximum.

AFTER-TREATMENT.

No small part of the success of all abdominal operations depends upon the after-treatment.

As soon as the patient is returned to bed he is allowed to lie quite flat or with one small pillow for an hour or two, until the effect of the anæsthetic is passing away. Then two or three or more pillows are given and the patient is propped up with them. After all operations upon the stomach and after some upon the gall-bladder, the patients are almost in a sitting position. This is generally far more comfortable for them, and does much to prevent

Fig. 13 —Position of a patient in bed immediately after the performance of gastro-enterostomy. As soon as the patient comes round from the anæsthetic he is propped up in this way.

the backache which many patients after abdominal operations complain of as their chief trouble.

Thirst is sometimes distressing within the first twenty-four hours; it is relieved by allowing the patient to flush the mouth out frequently with water, soda water, or Giess-hübler water. Nothing is given to drink until the feeling of sickness due to the anæsthetic is over, but after that there is no restriction as to quantity. A few sips of

water are given at first, tentatively; if these are retained and there is no nausea, the quantity is rapidly increased, and after twenty-four to forty-eight hours a couple of pints of fluid may be given during the daytime. I do not think there is need to stint the patient in the matter of fluids, as was at one time the universal practice. It seems to me not improbable that death took place in some of the cases I saw, in my earliest experience, literally from starvation. There is no harm done, so far as I have been able to determine, by allowing the patient to drink freely, provided the risks of vomiting are over. The need for fluid is greater in patients who are weak and in much enfeebled health. In old patients, especially in malignant cases, I have often given a cup of tea, or some other favourite drink, to the patient within three or four hours of the completion of the operation of gastro-enterostomy, or partial gastrectomy, and nothing but good has resulted.

After the first twenty-four hours, milk, soups, and a little jelly or pudding may be given. The giving of solid food I generally delay for five to ten days, according to the condition of the patient and the nature of the operation. A few grapes or the juice of an orange may be given from the first, and, as a rule, are much appreciated. In the choice of fluid food during the first few days I leave much to the patient, giving her or him those things which by earlier questioning we have found to be liked.

If fluid food is withheld, as was formerly the custom, the amount of urine excreted is often very small. In a long series of cases operated upon in the Leeds Infirmary during the time I was a resident officer, I found that between ten and twelve ounces was the average amount passed in the first twenty-four hours. The excretion of urine is always diminished after any abdominal operation, but over a pint should be passed in the first twenty-four hours.

I do not allow the catheter to be passed, as a rule. If there is difficulty in voiding urine a hot fomentation will generally be helpful. If no urine is passed at the end of twenty-four hours or if the patient is uncomfortable, the catheter is passed, with all the usual precautions. Some patients are found to pass a small quantity of urine, three or four ounces, frequently. It will generally be found that they have an overdistended bladder, and catheterism will then be necessary.

An exact record should be kept of the amount of urine passed until all danger from the operation is over.

Rectal injections of saline solution are given almost invariably for twenty-four or forty-eight hours, until, that is to say, the patient is getting a fair quantity of fluid by the mouth. I do not give any form of nutrient enema. Salt and water, one teaspoonful to a pint, with or without brandy, forms the usual enema. In quantity I give ten ounces or more as seems desirable, every three or four hours. Glucose may occasionally be given in the enema. It is water that is needed by the patient, and anything else given in a so-called nutrient enema is of no value.

Among the most important recent additions to the after-treatment of patients submitted to abdominal operations of any kind, the method of **proctoclysis** introduced by J. B. Murphy is undoubtedly the chief. The abundant supply of fluid by the rectum alters the whole aspect of a difficult and dangerous case; the appearance of the patient is greatly improved: the lips are red and the eyes clear; the skin acts freely; thirst is lessened or abolished and the pulse keeps full and slow. The amount of fluid which can be absorbed in this way is very remarkable. I have on many occasions administered 15 pints or more within twenty-four hours. Probably this is more than is necessary or desirable; 10 or 12 pints should be all that is needed. If a large quantity is absorbed the face and hands may become œdematous. The strain thrown upon the kidneys, especially if they are not fully

competent, by the administration of so much water and so large a dose of salt, may be a factor not always to be ignored; nevertheless in my own experience nothing but good has resulted from this lavish administration of fluids. It is possible that the colon ceases to absorb when the needs of the body are satisfied.

The mode of administration best adapted for the purpose is that originally introduced by Murphy: there have been several subsequent modifications by other surgeons, but no improvements. The cannula which lies in the rectum should reach a little above the sphincter; it should have a slightly bulbous end with large holes. The size of the holes, as Murphy insists, is of the first importance; for through ample apertures not only can the saline flow into the rectum easily, but flatus can escape through them, or the saline be forced back in an effort of straining, so that no fluid is expelled by the side of the tube. Moreover large openings are less likely to be blocked by fæces than small ones. The fluid is introduced approximately at the rate of 1 pint an hour for the first six or eight hours, then more slowly if the patient's needs are being satisfied. I employ the method in a great many cases: indeed, in all of any formidable character. (See "Lancet," August 17, 1907.)

Every twenty-four hours the rectum is washed out with a pint of hot water and soap. If flatus cannot be passed freely, a tablespoonful of turpentine is added to the enema. I find an enema of two ounces of glycerine and two ounces of water useful occasionally. The majority of abdominal cases are given one ounce of paraffin night and morning on the second and subsequent days.

The rectal tube is passed occasionally if thought necessary.

In the great majority of cases no bandage is needed. Three or four narrow layers of gauze are applied over the wound in all its length. Over these a large square piece of gauze is placed, and its edges are sealed to the skin by the application of a *formalin and gelatin mixture*. One ounce of gelatin sterilised by heating to 100° C. on three successive days in a test-tube is warmed until

it is liquid. To it are then added 20 minims of a 4 per cent. solution of formalin, and as quickly as possible the solution is spread over the edges of the gauze, where it speedily "sets." The dressing never slips.

The administration of morphine after an operation is rarely necessary nowadays. More especially since the introduction of Crile's method ("anoci-association") the pain after any operation has been quite inconsiderable. As a rule when this method is carefully and scrupulously carried out, the patient complains of no pain, unless he moves suddenly or coughs violently. If he lies tranquilly in bed he is free from pain, and looks quite himself. In some cases, however, especially for example in secondary gall-bladder cases, the injection can hardly be done thoroughly, and some relief from post-operative pain may be urgently requested. I never withhold morphine if the patient is suffering. In the old days we were all afraid of morphine, and surgery was often cruel. An injection of $\frac{1}{6}$ or $\frac{1}{4}$ gr. of morphine on the night after the operation will give a peaceful night and the patient wakes refreshed, and cheered by the repose he has had. I do not think that this amount of the drug causes any flatulent distension of the intestines; indeed I think by relaxing a spasm of the bowel it may aid in the expulsion of gas. It is rare for a second dose of morphine to be necessary: but in old people who are apt to be wakeful there is no reason against its administration. Aspirin will occasionally give much relief from pain, and I have in former days very often administered it in 10 gr. doses. These are questions which each surgeon will decide for himself. My own chief desire is to rob surgery of its terrors. Crile's method may prove to be the most powerful agent in effecting this; morphine and aspirin are useful auxiliaries in the severer cases. To give comfort to the patient by these means is not in the slightest degree to add to his dangers. It was the repeated administration of opium and morphine in the olden days that led to these drugs being discredited. Today we use them sparingly, but to the great advantage of our patients.

If there should be trouble from *flatulence*, and as a rule this is the only trouble that is met with, relief may be gained by the hypodermic administration of $\frac{1}{100}$ gr. of eserine sulphate.

In those serious cases of intestinal obstruction in which the over-distension of the bowel has almost paralysed the muscular coats of the bowel, great, indeed magical, relief may occasionally follow the injection of pituitary extract. The infundibular extract has been shewn by Blair Bell ("Brit. Med. Jour.," Dec. 4, 1909) to possess several properties: it raises the blood-pressure, it excites powerful contractions in the pregnant, puerperal and menstruating uterus, and it acts upon the intestinal muscle. In relation to the last of these Blair Bell writes: "I have now used this extract for intestinal paresis in a fair number of cases—fortunately with modern methods this complication is not so common as it used to be—and I have never known it to fail;" and again: "I myself venture to think that in infundibular extract we have at last found a reliable agent for the treatment of paralytic distension of the bowel." I have tried this substance in perhaps a dozen cases and my experience of it is that it is without doubt a valuable, if a capricious, remedy. It would appear that the greater the need for the remedy the more speedily and powerfully will it act. In cases of slight distension it has seemed to have no effect upon the intestine though the blood-pressure has been raised and the pulse rate lessened. In one case of intestinal obstruction operated upon after four days of complete closure of the gut, which had become enormously dilated, the patient who had a large and flabby heart died within a few minutes of the administration of the usual dose of the infundibular extract. Dr. Blair Bell subsequently warned me of the danger of giving the drug to a patient whose heart was in this condition.

The time during which the patient is kept in bed varies of course considerably, not only in different operations, but in different patients upon whom the same kind of operation has been performed. I find that it is a general custom to keep all patients in bed much longer than is necessary.

If all is going well, the sooner a patient is up the better. A patient, for example, after the removal of an appendix may be out of bed in six or seven days and may return to light work in a fortnight. A feeble patient, after the operation of gastro-enterostomy,—an old man with malignant disease, for example,—may be allowed to sit up in a chair on the fourth or fifth day. One patient, a medical man upon whom I performed gastro-enterostomy and cholecystotomy, was seeing patients on the fifteenth day after his operation, and, though this was done without my sanction, no ill effects followed. In all cases, however, the discretion of the surgeon must decide the practice in each individual case; no hard-and-fast rule can be laid down. All that can be positively said is that, provided all symptoms are favourable, there should be no unnecessary delay in allowing the patient to sit up.

If a patient is much enfeebled and wasted, I frequently order massage to the extremities within the first few days after operation. This is found most grateful to the patient, and prevents a feeling of extreme weakness when he is allowed to get out of bed.

During the whole of the time that the patient remains under treatment after operation the most scrupulous attention is bestowed upon the toilet of the mouth. The teeth are brushed frequently and some fragrant mouth-wash is used as often as possible. If the mouth is kept clean, the feeling of thirst is less noticeable. All fluid foods given are sterilised, both before and after the operation.

When drainage is employed, the tubes will need daily attention. If a drainage-tube is left in the wound, to drain the gall-bladder or the common duct, its outer end is fitted into a bottle of about ten ounces capacity which is fixed by a safety-pin to the side of the dressing. During the first few hours bile may flow in very small quantity, especially in cases where the action of the hepatic cells has been in part sup-

pressed by the tension and sepsis in the common and hepatic ducts, as a result of the occlusion of the duct by a stone. The bile that first flows may be muddy or turbid, but after a few days the bile flows in greater quantity and it becomes gradually clearer. The tube will then be removed if the stitch with which it is fixed has loosened.

If gauze packing has been used as a barrier around the gall-bladder in cases of acute cholecystitis, or elsewhere, it may be left until it has loosened—say, for eight days. Its removal then is almost painless. If the condition which has necessitated drainage is septic and offensive, a split rubber tube will perhaps have been introduced; this tube may be left in several days and shortened daily before its complete removal. Into the track left after its removal sterile vaseline or paraffin may be poured.

REFERENCES.

- Yates, "Surgery, Gynæcology and Obstetrics," December, 1905, p. 473 (where a full list of references is given).
Clark, "American Journal of Obstetrics," 1897, pp. 481, 650.

CHAPTER III.

**THE COMPLICATIONS AND SEQUELS OF ABDOMINAL
OPERATIONS.**

THERE are chiefly six:

1. Peritonitis.
2. Lung complications.
3. Parotitis.
4. Post-operative hæmatemesis.
5. Acute dilatation of the stomach.
6. Phlebitis and thrombosis.

Peritonitis.—The occurrence of peritonitis after abdominal operations has almost been abolished by the careful methods of modern surgery. In some cases, however, the risk of it cannot be avoided, for the operation may involve the handling of the lumen of the stomach or intestine which is septic, and from which the escape of organisms cannot wholly be prevented.

The careful preparation before operation will often effect a great reduction in the number and virulence of organisms in the stomach and the upper part of the intestine, as is elsewhere pointed out, but an adequate preparation is not always possible—as, for example, in cases of malignant disease of the stomach or in any form of acute disease of the stomach or intestine requiring urgent operation. The methods of preparation, the use of clamps to prevent leakage of contents in such operations, and the details of an aseptic operation faithfully observed have, however, done much to prevent the occurrence of any septic infection of the peritoneum. Nevertheless, peritonitis does occur, and is perhaps the most serious, if the least frequent, of all the complications of an abdominal operation.

It has long been a matter of earnest enquiry among surgeons as to whether it would not be possible, by some preventive inoculation, to render a patient more capable of withstanding the infection, during an operation, with any septic organisms. Experiments have been performed in the hope of discovering some means by which the danger of a peritoneal infection can be greatly diminished, and among these means prominence must be given to the production of hyperleucocytosis. The first investigators were Loewy and Richter, who attempted, by the injection of albumoses, especially spermin, to produce a hyperleucocytosis, and thereby to make the animals capable of resisting infection by pneumococci. Jakob, by the intravenous and subcutaneous injection of albumose into rabbits, made them proof against pneumococci and the organisms of mouse septicæmia. It was noticed that after each injection a hypoleucocytosis occurred first, to be followed speedily by hyperleucocytosis. If the infection was brought about during the time when the leucocytes were diminished, the animals without exception died; if, on the other hand, the infection was introduced during the time when the leucocytes were increased, the course of the disease was influenced in the most favourable way. Hahn succeeded in shewing that during the stage of artificial hyperleucocytosis, produced by nuclein and tuberculin, the blood of men and dogs possessed a higher bactericidal value than normal blood. Hofbauer, in Vienna, has obtained favourable results in undoubted puerperal septicæmia by the administration of five or six grains of nuclein by the mouth. After reviewing these facts Professor von Mikulicz, from whom they are quoted, writes ("Lancet," July 2, 1904):

"The question arises whether artificial hyperleucocytosis may not be of value in practice as a prophylactic. According to the above-mentioned experiments of Loewy and Richter, of Jakob and Hahn, one cannot exclude the pos-

sibility that, by a partly anticipated mobilisation of great masses of leucocytes, the latter may overcome the bacteria which had obtained entrance in the first instance in relatively small masses with greater ease than if the leucocytes delay their attack in force until the number and virulence of the bacteria in the tissues have markedly increased."

A series of experiments conducted by Miyake and authorised by Professor Mikulicz resulted in evidence that the injection of nuclein in animals prior to the infection of the peritoneal cavity by organisms had an undoubted effect in lessening the occurrence of peritonitis. Some of these experiments "consisted in performing a laparotomy and forcing through an opening in the stomach or intestine as much of their contents as could be obtained from the immediate neighbourhood of the incision. Of five control animals which had not been previously prepared, four died from peritonitis between five and sixteen hours after the operation. The fifth became extremely ill, but finally recovered, but the amount of intestinal contents which was transferred to the peritoneum was less in this case than in the others. Ten animals were prepared. These recovered without exception. The preparation consisted in three intraperitoneal injections of nucleic acid, two injections of neutralised nucleic acid. In each case laparotomy was performed seven hours after the injection. These experiments are such as to excite our interest in the highest degree, for by subcutaneous injections of nucleic acid it was possible to raise the resistance of the peritoneum to such an extent that even a considerable quantity of intestinal contents could be placed in the peritoneal cavity without causing damage, whilst without previous treatment an acute, rapidly fatal peritonitis followed almost without exception. This opens out a new field for the surgeon in preventing post-operative peritonitis."

In adopting the results of these experiments for the purposes of operations upon man, Mikulicz has administered fifty cubic centimetres of neutralised nucleic acid, 2 per cent.,

and has finally settled upon allowing a period of twelve hours to elapse between the injection and the operation.

In view of the novelty and importance of this subject, I may be permitted to quote the following summary of his experiments from Professor Mikulicz's article:

"The number of my experiments is not sufficient to permit me to form a definite judgment upon these points and to give an unguarded reply. We cannot, in the case of man, as we do in that of the lower animals when introducing infective material into the abdominal cavity, give a certain multiple of the minimum lethal dose in order to see how far a preventive treatment has succeeded. We set all our apparatus in action, in spite of preventive inoculation, to reduce infection to the minimum. Since this method fortunately succeeds in the majority of cases, even without preventive inoculation, in guarding the patients from a fatal peritonitis, a small number of satisfactory results do not prove much; but, on the other hand, one or two unsatisfactory results most certainly cannot condemn the method, for this method gives not absolute certainty like a specific immunisation, but only increases the natural immunity, and this may, in certain circumstances, even when increased to thirty-fold, nevertheless be insufficient. I have, however, the impression that the cases hitherto treated have given more favourable results, not only in the number of cases that recovered, but also in the progress of the individual cases, than the analogous cases of earlier date where the operation was performed without this preparation. In 10 cases of resection of the stomach for carcinoma, 9 recovered, 6 of them without the slightest complication. The progress was marked by a smoothness that was quite exceptional before this treatment was adopted. Two cases which presented exceptional difficulty in the removal of the carcinoma did undoubtedly within twenty-four hours develop peritonitis, with a pulse up to 160, which, according to our usual experience, foretold the most dismal prognosis. The patients fortunately survived this peritonitis. In the ninth case which recovered, the progress was disturbed from the fourth day by broncho-pneumonia.

The tenth case died; after seven days of uninterrupted progress he developed pneumonia, to which he succumbed three weeks after the operation. Of the remaining operations I should like to refer first to 22 cases of gastro-enterostomy and entero-anastomosis, 12 of which were for carcinoma. Of these cases, 19 recovered and 3 died. In all 3 cases death was most certainly not due to post-operative peritonitis, but in 1 case to perforation of an ulcerated carcinoma of the stomach two weeks after the operation; in another case, to continued hæmorrhage from a carcinoma of the stomach sixteen days after the operation; and in the third, to peritonitis arising from a tuberculous granuloma in the intestine four weeks after operation. Of 6 cases of resection of the intestines at one operation, 4 recovered and 2 died. In 1 case death occurred from collapse on the second day after a very prolonged operation of double resection for carcinoma; in the other case, where the injury was a bullet wound, death took place on the tenth day from hæmorrhage from the vena cava. In neither of the cases was there any peritonitis. One case of opening the stomach and stretching the cardiac orifice, performed on account of spasm, recovered. So also did 6 cases of operation on the bile-duct, 7 other operations upon abdominal organs without opening the intestinal tract, and 3 extra-abdominal operations. The last to be mentioned are two cases of nephrectomy, which were treated before the operation with nucleic acid. In both cases, in order to remove the suppurating kidney, the peritoneum had to be widely opened. One case recovered; the other died twelve days after the operation from hæmorrhage from the renal artery. In this case, too, there was no peritonitis. We therefore have 45 laparotomies in which the abdominal cavity was exposed to infection by the contents of the stomach or intestines or by some other infectious secretion; 38 of these cases recovered, and in none of the 7 fatal results was peritonitis the cause of death."

In addition to these measures there are others which have been used for the purpose of warding off an attack

of peritonitis or of combating its effects in the earlier stage. The chief among them is the inoculation with antistreptococcic serum. The use of this has been vaunted by Kader, but the general experience of surgeons tends to shew that it is of very little value, if, indeed, it has any value at all.

The free lavage of the peritoneum with hot saline solution, of which a large quantity is left within the abdomen when the wound is closed, has been shewn to lessen the likelihood of peritoneal infection, and to render the peritoneum better able to deal with the organisms which attack it. It has become a practice among many surgeons of great experience, Mikulicz among them, to employ this drenching of the peritoneum more and more. It is not a method which has ever appealed to me, and it is not my practice to flush the peritoneum except in infected cases where there are gross particles either of septic material, lymph, or of food stuffs.

Peritonitis is to be suspected when, after operation, pain, instead of subsiding, gradually becomes more and more intense, when the abdomen becomes prominent and tympanitic, and the intestines distended and motionless. In such circumstances the pulse gives the surest indication of the patient's condition. When the pulse rises steadily in frequency and its quality becomes progressively poorer, a most serious condition is present or impending. When the pulse-rate is below 100 there is, as a rule, no cause for anxiety; but with a pulse-rate rising gradually from 120 to 140 or even higher, in the absence of chest complications, the existence of peritonitis may be confidently predicted. The patient, as a rule, looks anxious and careworn and wears a frowning expression. Cyanosis and cold, clammy extremities indicate approaching dissolution. As a rule, there is some elevation of temperature in the early stages; but later the temperature may be normal or subnormal.

It is a factor of little importance. The patient lies with his hands above his head and his knees drawn up; straightening the thighs causes an increase in the abdominal pain. Vomiting and hiccough are sometimes persistent. An ounce or two of fluid, perhaps stained black by digested blood, may be vomited every few minutes, and, though lavage relieves this symptom for a time, it is almost certain to return. As the toxæmia deepens the patient gradually becomes numbed to his pain, and will often express himself as feeling much easier; this is a bad sign. The skin is dry, until near the end, when a cold sweat covers the patient. The tongue is dry and coated, and the secretions all are scanty. It is, however, the steadily increasing rapidity in the pulse-rate, together with a steady fall in the character of the pulse, that gives most cause for anxiety.

As soon as the indications of a commencing peritonitis are observed, measures must at once be taken to secure a free action of the bowels. If a copious evacuation of flatus or fæces can be compelled, the great probability is that the patient can be saved. Unfortunately, the administration of any aperient by the mouth is little likely to be of use, for the drug will often be vomited within a few minutes. Enemata containing turpentine or enemata of oil introduced high into the colon are the chief measures upon which reliance must be placed. One of the things most needed in therapeutics is an aperient that can be administered hypodermically. Sulphate of eserine in $\frac{1}{100}$ gr. to $\frac{1}{60}$ gr. doses may be employed or pituitary extract, as first advised by Blair Bell.

Is it worth while, in cases of general peritonitis, to reopen the abdomen and to attempt to cleanse and to drain it? The infection which underlies the symptoms mentioned above is so universal that any operative treatment would be in itself a most hazardous procedure, when applied to a patient who has already borne the strain

of a serious operation. In the early stage of these cases one has hope of being able to cut short the disease by brisk purgation. When this has failed, the patient's condition is such that little hope of relief can be entertained. There are cases, however,—though in my opinion they are few,—when a reopening of the abdomen is not only justified, but is absolutely necessary if the patient is to be saved. These are the cases where the infection can be traced with reasonable certainty to a definite source; such as, for example, leakage from the giving way of an anastomosis accomplished by the Murphy button or by suture, or soiling due to the escape of infective material from the intestine during the operation. In such circumstances the continued infection must be stopped by appropriate measures of repair, and the soiled parts must be thoroughly cleansed, and, if need be, drainage must be established. Should a generalised post-operative peritonitis occur, the treatment does not differ from that of peritonitis due to an appendix, a perforated ulcer, or any other lesion,—namely, suppression of the cause, little or no irrigation and no free handling of intestines; Fowler's posture should be adopted to facilitate respiration and to collect fluid in the pelvis and thus preserve the most absorptive portion of the serosa. Proctoclysis here is invaluable and gastric lavage may be necessary.

Lung Complications.—Chest complications formerly occurred frequently after abdominal operations. In the surgery of the present day their occurrence, though greatly diminished, is still far greater than it should be.

The following lung complications are known to follow any abdominal operation: pneumonia; pleurisy; bronchitis; œdema of lungs; abscess of lung; massive collapse; pulmonary embolism; gangrene of the lung. Any one of these may follow a simple or a serious operation, a short, or a prolonged one. The cause of the lung implication has been closely investigated, and a variety of explanations have been offered. The suggestion was long ago put forward with confidence that the anæsthetic

was the responsible agent. The chilling and irritating effect of ether upon the mucous membrane of the respiratory tract resulted in a profuse secretion from the inflamed surface. The aspiration of saliva has also been blamed. It was not long, however, before it was found that all these chest troubles might follow upon operations which were performed under local anæsthesia alone.

It is well known that for a few days after any abdominal operation the wound may feel stiff and sore, though it is not actually painful. The taking of a deep breath or the act of coughing causes a sudden "stitch" in the wound, and the patient feels as though a free effort at coughing would tear the wound edges apart. It was suggested then that the immobilisation of the abdominal muscles, in the unconscious protection of the wound area by the patient, resulted in an accumulation of the bronchial secretions in the lung. A deep breath was not taken; the breathing remained thoracic in type, and the air-passages were not cleared in the act of coughing. The lung then became irritated and waterlogged by retained secretions. In favour of this suggestion is the fact that all forms of chest involvement are more frequent after operations performed in the upper abdomen. Statistics from Körte's clinic shew 10 per cent. pulmonary complications in operations above the umbilicus and 6.6 per cent. in operations where the abdomen was opened below the umbilicus. W. Pasteur ("Lancet," Oct., 1910) believes massive collapse of a lung after abdominal operations to be a direct result of reflex inhibition of the diaphragm causing deflation of the pulmonary bases. He writes: "Whenever—whether as the result of paralysis or of temporary reflex inhibition of muscular action—the distending force acting on the lungs becomes less than that of the elastic and muscular agencies which tend to cause its contraction, these latter, so to speak, take charge, with the result that the affected portion of the lung rapidly empties itself of its contained air." It is quite possible that in patients operated

upon for conditions in the upper abdomen pleurisy is often the result of a post-operative inflammatory reaction extending to the diaphragm and pleura.

A factor which is, without question, one of great importance is the chilling of the patient before, during, and after the operation. It was, at one time, the custom in many hospitals to send all the patients to the bath on their arrival. After the bath, a thin cotton shirt was given to them—no matter what form of clothing had been worn on admission. Furthermore, during the operation, in a room perhaps not overwarm, a considerable part of the patient's body was exposed, and if the cleansing of the skin were done by a house-surgeon fond of a splash, a pint or two of lotion was allowed to run down underneath the patient. A thinly clad patient, most of whose abdomen was exposed, was, therefore, lying on a cold, damp table for perhaps an hour—a most unsatisfactory condition of things.

The patient should have warm clothing on arrival; before the operation he should be clad in a suit of gamgee pajamas; as little of the abdomen as possible (though as much as is necessary) should be exposed; the operation room should be well warmed; if necessary, the table should be a hot-water table; operations should be done expeditiously. There should, moreover, never be undue exposure or handling of viscera, so that no unnecessary shock may be caused.

In some cases I feel sure that the cause of the lung implication is to be found in the inhalation of septic matter. This septic matter may come from the patient's own mouth, or it is conceivable that a dirty inhaler may be responsible for it. Of the necessity for cleanliness in both these directions there is no further need to speak.

In some cases the pneumonia has been proved to be due to embolism, the septic emboli being derived from

the operation area. In operations upon the stomach or intestine in particular, thrombosis of veins may result from unduly rough handling or from infection of the wounds. Neatness and a certain dainty fastidiousness and the utmost cleanliness in all operations are things to be cultivated.

There can be little doubt, I think, that in some cases the long continuance of the Trendelenburg position in pelvic operations is productive of harm. The viscera are pressed against the diaphragm, whose freedom of action is thereby limited. There is congestion of the lungs as a result of the gravitation of blood to the dependent parts. It is my custom to perform the early and late steps of any pelvic operation with the patient in the usual horizontal position. As soon as the Trendelenburg position is necessary, the table is altered by the anæsthetist in a moment; as soon as the pelvic part of the operation is completed, the table is again made horizontal. The patient, therefore, remains the briefest possible time in this constrained position.

It has become a general custom, more especially among resident officers, to give intravenous saline injections to all patients who are suffering in any serious degree from shock. The custom has much to recommend it, but I am strongly disposed to think that it is not seldom provocative of harm, for, in some cases, when large quantities of fluid are injected, an acute œdema of the lung, with copious frothy expectoration, occurs. On postmortem examination of such cases it can be seen that there is an acute œdema of both lungs; the lungs, in fact, are waterlogged. Saline infusions are remedies we cannot afford to do without, but a little more discretion than seems to be generally customary should be exercised in their administration. Above all, it should be seen that the fluid injected is of proper temperature, that no air is allowed to get into the vein, and that the quantity injected does not exceed

three pints. As much as five or six pints have been frequently given; but I do not think that as much benefit results from one large injection as from two smaller ones given with an interval of twelve or twenty-four hours.

Professor Mikulicz used to order all his patients, after abdominal operations, to breathe deeply for a few minutes two or three times daily in the belief that the tendency to stagnation in the lung bases is thereby relieved and broncho-pneumonia prevented.

From the foregoing discussion it will be realised that, though the possible causes or influences giving rise to the lung complications after abdominal operations are many, it is not to any one of them that paramount importance can be attached. The surgeon's part, therefore, must be to safeguard his patient by all the means in his power from all these harmful influences; and he will find that by so doing the risk of the occurrence of these most serious disasters will be greatly lessened, if not entirely abolished.

The treatment of the lung complications following abdominal operations does not differ from that which is observed in the cases as they are ordinarily seen.

I have come to place much reliance upon the frequent use of the steam inhaler with or without tincture of benzoin or other stimulant. The patient always expresses himself as much relieved by it, and a copious expectoration generally results from each use of the inhaler. A mixture containing digitalis, vinum ipecacuanhæ, and carbonate of ammonium generally gives relief. In 5835 major operations at the Mayo Clinic pulmonary complications occurred in 89 cases or .015 per cent.

Bibergeil ("Archiv f. klin. Chir.," Bd. lxxviii, Heft 2, and "Brit. Med. Journ.," Epitome, March 17, 1906, p. 41, No. 170) publishes the results of an analysis of 3,909 abdominal operations, including those for strangulated and reducible herniæ,

practised in Körte's clinic, and points out what he concludes to be the most likely causes of postoperative pneumonia in this class of cases. Notwithstanding the protection afforded by modern aseptic methods against peritoneal infection, this pulmonary complication occurs, it is stated, more frequently after laparotomy than after any other major operation. Pneumonia followed in 135 of the collected cases, and presented in 10 instances the croupous or lobar, in 98 the lobular, and in the remaining 27 the hypostatic form. Other complications, such as pulmonary embolism and abscess, bronchitis, pleurisy, and empyema, occurred in 147 other cases. In this study of the causes of pneumonia in abdominal surgery, the author finds that the occurrence of this complication is not influenced in any way by the condition of the wound. Of 10 cases of the croupous and distinctly septic form of pneumonia, 8, so far as the seat of operation was concerned, were aseptic, and 2 only were septic. Careful study of the collected cases of postoperative pneumonia has led, he states, to rejection of the views that this complication may be due to infection by way of the lymphatics, and to such causes as exposure to cold of the surface of the body or of the peritoneal cavity to abdominal irrigation, and to direct action of a general anæsthetic. The lobular form, or broncho-pneumonia, which is most frequently met with after laparotomy, is regarded as being usually the result of autoinfection due to aspiration of secretions from the mouth and pharynx whilst the patient is under the full influence of an anæsthetic. It is pointed out that the interference with free breathing and expectoration resulting from pain at the seat of operation and impeded movements of the incised abdominal wall, must favour very much the development of lung disease after laparotomy, whilst the resistance to the inflammatory attack is in many cases much impaired in consequence of the enfeebled condition of the patient. In concluding, the author recommends, as suitable prophylactic measures, thorough cleansing of the mouth and throat and irrigation of the stomach before the operation; a

cautious administration of the anæsthetic, the patient's face being turned to one side to permit a free external flow of oral secretion; prevention of chilling of the surface of the abdomen during and after the operation; the application of thick and warm compresses to the wound, and avoidance of tight bandaging; frequent change of the patient's position in bed during the after-treatment; and as speedy a release from the recumbent posture as the state of the wound will allow.

Parotitis.—An acute attack of inflammation in one or both parotid glands may follow upon an operation upon any abdominal organ. I feel sure that the frequency of this most trying complication is decidedly less than it was.

In 1887, Stephen Paget collected the records of 101 cases, and investigating their causes, found that in—

- 10 cases parotitis arose after disease or injury of the urinary tract.
- 18 " parotitis arose after disease or injury of the alimentary canal.
- 23 " parotitis arose after disease or injury of the abdominal wall, peritoneum or pelvic cellular tissue.
- 50 " parotitis arose after disease or temporary derangement of the generative organs.

The preponderance in this series of cases following upon operations upon the ovaries was doubtless due to two facts,—one, that at the time these cases were recorded abdominal surgery was confined very largely to the pelvic organs; the other, that the starvation of the patient was considered a necessary incident of success; no drop of water was given, perhaps for days, and the mouth was parched, the tongue dry and hard. In those days the surgery of the stomach and gall-bladder was in its earliest infancy. Operations were few, and patients were not often fortunate enough to survive to develop parotitis.

The time of the appearance of the inflammation is usually towards the end of the first week after operation, but cases are recorded in which the inflammation began at the end of six weeks. In about one-third of the recorded cases both glands have been affected, the involvement of one preceding that of the other by two or three days, as a rule.

The causes of secondary parotitis remained long obscure. It was at first regarded merely as a variety of mumps, or primary parotitis, until experience shewed that there were two very marked differences between them,—primary parotitis being an infectious and non-suppurative disease, secondary parotitis being non-infectious and prone to suppurate. Three chief theories have been held with regard to the nature of this disease.

For able discussions of this subject see Dyball, "Annals of Surgery," vol. xl, p. 886, and Rupert Bucknall, "Lancet," vol. ii, 1905, p. 1158, to both of whom I am indebted for some of the following particulars:

1. *The Pyæmic or Embolic Theory.*—This was the first of the theories to receive general approval. It was universally recognized at one time that secondary parotitis occurred in association with operations where suppuration took place, and it was not unnaturally supposed that the incidence of this phenomenon was due to septic embolism of the parotid vessels, the infected clots being derived from the neighbourhood of the suppurating wound. But the objections to this view were soon recognised to be two,—secondary parotitis was known to follow operations where no obvious infection had occurred, when no evidence of thrombosis was present; and in fatal cases, even when there had been suppuration in the original wound, there was sometimes no sign of venous thrombosis, and no discoverable source there, or elsewhere, of septic emboli.

Undoubted instances of pyæmic infection of the parotid gland have occurred, but the glandular infection has only developed at a late stage of the disease and long after other parts have suffered.

The known facts, therefore, with regard to secondary parotitis were that it occurred apart from other pyæmic manifestations in the great majority of cases; that, in fatal cases, no source of infected emboli could be discovered; that in cases where metastasis undoubtedly occurred other parts than the parotid

were affected, and were affected at an earlier stage. Bucknall writes:

"More recently the question of embolic origin has been definitely proved to be incorrect, for it has been shown by microscopic examination that the conditions present are different in secondary parotitis, and in parotitis of pyæmic origin. In the former instance the process of inflammation begins around the ducts in the centres of the lobules, and, moreover, many

Fig. 14.—*Parotitis, early stage.* Vessels normal; small duct blocked with débris. walls breaking down; tissue around inflamed and infiltrated with small round cells; large duct blocked with débris, containing organisms to high power; blood-vessel unaffected (Rupert Bucknall).

lobules are simultaneously affected. In the latter the inflammation begins around the arteries which run in the perilobular tissue and the inflamed mass is a single one, involving the area of gland-tissue supplied by the particular vessel which has become blocked with septic clot."

2. *The Sympathetic or Reflex Theory.*—This theory owes its origin, or at least its chief advocacy, to Stephen Paget. It rests upon a supposed sympathy existing between the parotid

glands and the generative organs, and in support of it is quoted the known relationship existing between mumps and orchitis or ovaritis. Such a view as this, however, is not in accordance with modern pathological views. A closer investigation of the so-called "sympathetic" affections shews that it is infection, and infection alone, which is the cause of the acute inflammatory manifestations. The appearance of a theory such as this was perhaps not surprising at a time when, as I have said,

Fig. 15.—*Parotitis, more advanced.* Infected ducts and adjacent central parts of lobule breaking down to form abscess cavities (Rupert Bucknall).

almost all abdominal operators were concerned with the generative organs of the female.

3. *The Duct-infection Theory.*—The suggestion that secondary inflammation of the parotid was due to direct infection of the gland by the invasion of the duct by organisms from the mouth was made by Hanau and Pilliet in 1889. So good an account of this view is given by Bucknall that I take the liberty of quoting it in full:

They found on microscopical examination of sections of the parotid (1) that the ducts were choked with débris containing micro-organisms; and (2) that the inflammatory processes present invariably began around the ducts in the centre of each lobule and only spread later to the periphery of the lobule and the perilobular connective tissue in which the blood-vessels are situated. They concluded, therefore, that secondary parotitis could not be of embolic origin, or else the inflammation would

Fig. 16.—*Parotitis, late stage* Gland tissue destroyed and replaced by inflammatory products, which are breaking down to form abscess cavities; vessels not thrombosed or specially inflamed (Rupert Bucknall).

have originated around the vessels, and that the fact that inflammation began simultaneously in the centres of many lobules at once, pointed to an ascending infection of the ducts as the real source of the affection,—a conclusion which was further borne out by the actual presence of micro-organisms in the ducts themselves in such cases.

Additional evidence of different kinds has been subsequently brought forward in support of this view.

(1) Microscopic sections serve to show that in all cases of secondary parotitis the disease pursues the following course: (a) The ducts become blocked with débris containing micro-organisms. (b) Inflammation first begins in the centre of each lobule around the ducts, and at a point farthest away from the vessels. (c) Many lobules are simultaneously affected; they each become centrally necrosed and then, finally, by extension they fuse to form a multilocular abscess cavity.

Fig. 17.—*Parotitis, late stage.* Shewing multilocular abscesses in sites of ducts, and general small-cell infiltration of lobules (Rupert Bucknall).

(2) Bacteriological examination, first carried out by Girode, has served to prove: (a) That several different kinds of organisms may give rise to secondary parotitis, the commonest being the staphylococcus, the next frequent the pneumococcus, and after that the pneumobacillus, the typhoid bacillus, the colon bacillus, and the streptococcus, in order of frequency. (b) That on taking cultivations from the gland itself, the pus contained in it, the orifice of Stenson's duct, and the oral cavity respectively, the organisms found at each spot are invariably

identical in each individual case, a fact which supports the conclusion that the infection of the gland spreads from the mouth via the duct. (c) That the organism giving rise to secondary parotitis is by no means invariably the same as that giving rise to the primary disease during the course of which the attack of parotitis has arisen. Thus, in the cases complicating pneumonia the organism causing parotitis may be the pneumococcus or the staphylococcus; in typhoid fever it may occasionally be the typhoid bacillus, but it is much more commonly the staphylococcus or pneumococcus. In embolic parotitis due to pyæmia, on the other hand, the organism in the parotid is invariably identical with that giving rise to the primary disease and the abscesses in other parts of the body.

Microscopical or bacteriological evidence of direct or ascending infection has been brought forward by the following observers: Girode (12 cases), Prantois (2 cases), Diaz, Swain, Bosquier, Morley, and Subkovski. Toupet, Testa, Subkovski and Fischel found the pneumococcus in the gland in cases of lobar pneumonia, and Janowski and Lehmann found the typhoid bacillus in cases of enteric fever. Girode, on the other hand, found the staphylococcus to be the cause of the parotid infection in a case of pneumococcus pneumonia, and the pneumobacillus to be present in the gland in a case of puerperal septicæmia of streptococcus origin. Various observers, moreover, have shown that parotitis complicating enteric fever is far more frequently due to the staphylococcus than the typhoid bacillus.

Post-operative Hæmatemesis.—Hæmatemesis which follows upon operations upon the stomach, and is obviously due to the improper or imperfect application of sutures in the formation of an anastomosis between the stomach and the duodenum and jejunum, is not considered in the following remarks.

Post-operative hæmatemesis follows far more frequently upon operations involving the opening of the abdomen

than upon any other operations. It is true that cases of even fatal hæmatemesis have occurred after operations upon the bladder or urethra, upon the head, and upon the extremities; but all these cases together do not, in number, form a tithe of those which are seen after abdominal operations.

In the majority of instances hæmatemesis begins within twenty-four hours of the operation. The blood which is vomited has always been in the stomach a sufficient length of time to become partly digested, the result being that the vomit is always black. "Black vomit" is the name by which the condition is chiefly known by nurses. The patient may or may not have suffered from ether or chloroform sickness; but, whether he has or not, there is usually an interval between the cessation of this and the commencement of the hæmatemesis. As a rule, the amount vomited is small; there are rarely more than two to five ounces at a time. The characteristic condition is for an ounce or two to be vomited at frequent intervals. The vomit is often intensely acid, and burns the patient's mouth, throat, and lips. In many cases a broad, red mark on the chin or cheek will shew where the vomited fluid has run down to the basin, and the lips often become swollen, red, and very tender, for the patient makes little or no effort to expel the fluid, allowing it to trickle away from his mouth.

The general condition of the patient is always bad. The aspect indicates a condition of profound depression. The pulse is small and rapid, the skin cold and moist, the limbs clammy with sweat. The temperature is often subnormal. There is, as a rule, a rapidly progressive collapse. Indeed, in the severest cases one cannot but feel that the patient is the victim of a profound toxæmia—that a poison of unusual virulence is killing him. Patients are often curiously sensitive to all impressions in the early

stage—their mental alertness is remarkable, but their comments soon become spasmodic and jerky, and *mal à propos*, and lethargy, dulness, and general inertia rapidly follow.

In a very large number of the recorded cases a fatal issue has occurred. In a series of twenty-nine cases referred to by Purves ("Edin. Med. Jour.," March, 1902) the death-rate was equivalent to 69 per cent., and this estimate is approximately that which is given by the majority of writers, though from my own experience I believe it to be a gross exaggeration. Hæmatemesis follows upon any abdominal operation, but is more especially to be looked for when the stomach, duodenum, or bile-passages are the seat of disease. The time of onset, though usually within the first forty-eight hours, may be delayed for as long as ten days.

The cause of the hæmatemesis is not definitely known. A great variety of theories have been suggested. Among them are the following:

Firstly.—It has been suggested that the anæsthetic is the cause of the bleeding. It is, however, an undoubted fact that precisely the same symptom may be observed when the operation has been performed under cocaine.

Secondly.—Distinct injury to the stomach or duodenum is said to result in ulceration, from which the blood comes. In some cases an ulcer or several ulcers have been found on postmortem examination. It is suggested that the damage done to the stomach produces a local necrosis, and that the gastric juice then digests the slough, and an ulcer results. Krönlein, however, has shewn that, in order to produce ulcers in this manner, several days must elapse between the time of the receipt of the injury and the time when an ulcer is found. Though this explanation may be acceptable for some cases, it cannot, therefore, apply to them all.

Thirdly.—The suggestion put forth by von Eiselsberg—

who, in 1899, first drew prominent attention to this symptom—was that injury to the omentum was the immediate cause. Rough handling or twisting or ligation of the omentum produced a thrombosis of the omental vessels followed by embolism in the wall of the stomach, and in consequence ulceration of the stomach resulted. Purves writes on this point:

“In reference to the stomach, in particular, von Eiselsberg considers that, after ligature of the omental branch of the epiploic artery, the vessel becomes thrombosed and the thrombus extends back to the origin of the vessel. The vessels lie at right angles to one another, and he conceives that a portion of the thrombus projecting into the epiploic may be swept off into the passing stream and carried on into some of the branches going to the stomach-wall, there to form a thrombus and ultimately a digestive ulcer. He considers that this is the most prominent etiological factor in the production of post-operative hæmatemesis.”

The suggestion is one which, doubtless, contains some measure of truth, but it is not, of course, applicable to all cases.

Fourthly.—W. L. Rodman has suggested that sepsis is the chief cause. This seems to me to be the most likely of all the explanations that have been given, though it cannot be denied that in some instances the obvious evidences of sepsis elsewhere are wanting. In some of these cases it may be that the sepsis is of such a character as to produce a rapidly fatal toxæmia, the poison acting so rapidly, indeed, that local evidences—peritonitis, etc.—have no time to develop.

In this connexion recent inquiries conducted at the London Hospital are of the greatest interest. They shew more clearly than any other pathological records of which I have knowledge how dependent a severe hæmatemesis may be upon lesions which

are primarily unconnected with the stomach. Hutchinson records 24 cases of fatal hæmorrhage from the stomach after operations of various kinds upon the abdominal viscera. Of these 24 no less than 21 were cases of appendicitis with septic complications, localised abscess, or diffuse peritonitis. In three cases recent acute ulcers were found in the stomach (twice) and in the duodenum (once); in the remaining cases only "hæmorrhagic erosions" were found. The origin of this serious and profuse bleeding is ascribed to a profound alteration in the blood due in most cases to toxins of septic origin. The experiments of Wilkie would make it appear probable that a retrograde venous embolism from the original septic focus may be responsible for the development of acute ulceration in the stomach or duodenum.

Fifthly.—Mayo Robson, disputing the theory suggested by Rodman, writes: "The only explanation that seems at all feasible is that the hæmorrhage is dependent on a reflex nervous influence." The apt comment of Purves on this statement is: "This is no more easy to prove than the other suggestions; but, if it were a true solution of the question, it is, I think, admissible to suppose that sepsis would, in many cases, determine the onset of the reflex or prolong the duration of its action, and thus render the condition more serious."

The treatment of hæmatemesis will depend in part upon the condition of the patient. In those whose condition is fairly good, lavage of the stomach with a tepid solution of bicarbonate of soda will generally arrest the sickness and give relief. The bowels should be compelled, if possible, to act freely; high enemata of soap and water or oil must be given. Sips of water containing adrenalin chloride solution—ten minims to a teaspoonful—should be given every half-hour; the general and the local effect of this drug are both desirable. Calomel may be given in doses of one-half grain every half-hour.

The abdominal bandage should be applied firmly—as firmly, indeed, as the patient can bear it.

If the symptoms of toxæmia are well marked, an intra-venous infusion of saline solution will prove of value.

Reichard has reopened the abdomen in two cases for the purpose of searching for the source of the hæmorrhage in the stomach. This is a futile and useless procedure.

Acute Dilatation of the Stomach.—This is among the least frequent but most serious complications which may follow upon an abdominal operation. A large number of cases have now been reported, and an excellent review of many of them published by Campbell Thomson ("Acute Dilatation of the Stomach;" Bailliére, Tindall & Cox, London, 1902).

Symptoms.—The symptoms appear as a rule rather insidiously after an abdominal operation. The chief of them are pain in the epigastrium, constant, effortless vomiting of a thin greenish or greyish turbid fluid, a rapid and steadily increasing pulse-rate, and symptoms of collapse or exhaustion. The act of vomiting is not often distressing though its frequent repetition may be exhausting. As Henry Morris remarked of one of his cases, the vomit is brought up "in large gulps without straining." The surgeon's attention should be drawn to this complication by the repeated vomiting and the constantly increasing pulse-rate. An examination of the abdomen will then reveal a tight distension of the epigastrium, and when the bandages are removed, the outline of the grossly inflated stomach may be marked. The passage of the stomach tube allows a huge volume of gas to escape, often with a miniature "report," and a large volume of thin greyish fluid will be evacuated. As soon as the tube is withdrawn, the stomach may begin almost at once to refill, and within half an hour its distended form may be recognised upon inspection of the abdomen. When the stomach distension becomes, as it may, gigantic, the bulging of the abdominal wall is mostly to the left and in the lower half; the right hypochondrium by contrast has been said to be flattened or excavated.

In other cases, though the abdomen is large, tense, and resisting, no special bulging at any point can be seen, while in yet others the abdomen may be, as in Henry Morris's case, retracted. In this instance, at the postmortem examination, although the stomach was enormously dilated and occupied the greater part of the abdomen, its anterior surface was said to be flattened.

The general condition of the patient is recognised as being serious from the first. The respirations are frequent and shallow;

Fig. 18.—Acute dilatation of the stomach (Campbell Thomson).

the pulse is rapid, thready, and of poor quality; the aspect of the patient shows that his tissues are starved of water; he is pinched and careworn and old in appearance, and the limbs are often cold and clammy. Thirst is intolerable and unquenchable; the patient is restless, and at times irritable and weary. Diarrhoea has been occasionally observed. The amount of urine in nearly every instance in which special attention has been given to the point has been very considerably reduced in quantity, or the secretion entirely abolished.

Pathology.—The appearances presented on postmortem examination are curiously similar in almost all cases. The stomach is enormously distended, and is sharply bent upon itself, so as to form a gigantic U-tube, whose distal limb is rather shorter and less thick than the proximal. At the lesser curvature there is therefore a sharp kink. The stomach seems to occupy the greater part or even the whole of the abdomen, cutting off from sight and severely compressing all the small and large intestine. The walls of the stomach are tightly stretched and thinned, in one case seeming no thicker than a single layer of peritoneum. The thinning of the walls is not equally distributed; very thin patches are sometimes seen, the greater part of the stomach remaining normal, or nearly so. In 12 cases out of 44, the dilatation was not limited to the stomach, but involved the duodenum also, and in one case the upper few inches of the jejunum. Box and Wallace have shown that the condition found in acute dilatation of the stomach can be exactly reproduced on the cadaver. They write:

“We have found by actual experiment on the cadaver that the stomach can be enormously distended by water pressure, with the jejunum cut right across and lying patent in the abdomen. Moreover, the stomach remains thus distended. The same result can be attained after the superior mesenteric vessels and the peritoneal folds in their neighbourhood have all been divided. If, however, by introduction of the finger well behind the distended stomach a little to the left of the mid-line of the spinal column, the fundus and posterior wall of the stomach be gently raised, the excess of fluid will at once flow freely away from the stomach through the cut jejunum. If the part of the duodenum which lies on the right side of the spine, behind the peritoneum, be first incised, the tense distension of the stomach cannot be produced. We therefore feel justified in assuming that the tense distension is due to actual pressure of the stomach on the part of the duodenum which crosses the third and ascends by the side of the second lumbar vertebra to end in the jejunum.

“We would suggest, therefore, that in producing the train of

symptoms met with in acute dilatation of the stomach two factors come into play. There is, first, a paralytic condition of the viscus which leads to distension, and then, at a certain stage, the distended stomach actually produces obstruction by pressing on the duodenum on the front and to the left of the spinal column." ("The Lancet," November 9, 1901, p. 1260.)

A large number of more or less ingenious hypotheses have been suggested to explain the incidence of acute gastric dilatation, but none of them are completely satisfying.

By Fagge and others an excessive secretion of the stomach was considered the primary factor, the organ being "paralysed from overdistension, and unable to rid itself of its burden." Henry Morris, who considered the excess of secretion to be an important determining cause, suggested the name "gastro-succorrhœa" for this disease. In several cases, however, the distension of the organ is not by any means wholly or even chiefly due to the fluid contents; for when the stomach is emptied of gas by a stomach tube, and before any fluid has escaped, the viscus may return almost to its normal size. Campbell Thomson writes:

"It is, of course, a difficult matter to establish precisely the relationship which exists between the distension and the secretion, but it seems probable that they must be looked upon as two distinct processes.

"The most likely explanation seems to be that the stomach wall becomes paralysed—the possible causes of which will be discussed further on—and then, later on, the organ becomes distended by gas or excessive secretion. Moreover, the fact that excessive secretion is not present in every case makes it impossible to consider it as the primary cause; in some cases there is very little fluid found after death, the stomach being almost entirely distended with gas."

Pepper and Stengel suggest that the immediate cause of the dilatation is a spasm of the pylorus; but if this were so, the not infrequent implication of the duodenum would be still

to explain. Wiesinger considers that there is a volvulus of the stomach, and that the distension is similar to that found in a twisted sigmoid flexure.

Albrecht was the first to suggest that the constricting agent is the superior mesenteric artery, which, owing to the downward dragging of the intestines, presses upon and obstructs the third portion of the duodenum. Kundrat, Ewart, and others have offered evidence in support of this view, and there is little doubt that in some cases, at least, the explanation is satisfactory. Albrecht points out that if the descending portion of the duodenum be opened and the finger passed onwards into the transverse portion, and with the other hand traction be made upon the mesentery by pulling the intestines towards the pelvis, the constricting power of the superior mesenteric artery will be clearly recognised. In Jessop's case, and in others, the distended duodenum was abruptly narrowed at or near the point of crossing of the artery; but in other cases, and these form a majority, there was no constant point at which the stricture was found.

T. Ordway ("Bost. Med. and Surg. Journ.," March 5, 1908) writes as follows describing the post-mortem report upon a case of acute dilatation in a moribund phthisical patient: "The mesenteric attachment which crosses the last part of the duodenum is tense. It presses the duodenum against the spinal column and this produces complete obstruction. Above this obstruction the duodenum is markedly dilated and continuous with the stomach. Below this point both small and large intestines are collapsed and apparently empty."

An interesting point in connexion with the clinical history of this case is that although the vomit frequently amounted to two quarts within ten or fifteen minutes, there was no abdominal distension; on the other hand, there was marked retraction and muscular rigidity.

The view which seems to be most highly favoured by the majority of writers is that the paralysis of the muscular wall

of the stomach is primary. Carrion and Hallon ("Sémaine Médicale," August 21, 1895) have shown that the section of the pneumogastric nerves in the dog leads to dilatation of the stomach, and to symptoms resembling in many cases those of uræmia. It is clear that in some instances, as soon as the stomach has reached a certain size, it is almost impossible for it to recover, either because there is some kinking or rotation at the pylorus, or because pressure is exerted, as Box and Wallace suggest, upon that part of the duodenum which crosses the third and ascends by the side of the second lumbar vertebra in the left side.

Attention has been specially drawn by P. Müller ("Deut. Zeit. f. Chir.," August, 1900) to dilatation of the stomach following upon abdominal operations. In some of these cases the gastric distension is only a part of a general involvement of the intestinal canal, due to peritonitis. The septic condition induces a paresis of the bowel walls, and distension of the gut rapidly follows. In other cases, and it is these to which Müller draws particular attention, the dilatation of the stomach is due to the pressure upon the duodenum of the superior mesenteric artery. When a large ovarian tumour or a fibroid tumour of the uterus is removed, the intestines, compressed for many months or years to the upper part of the abdomen, sink down into the pelvis, and so drag upon the superior mesenteric artery as to compress the duodenum in the manner already described.

L. A. Conner ("Medical Record," i, 1907), who has analysed 102 cases of acute dilatation, concludes that the condition occurs most frequently after operation under general anæsthesia, and is usually associated with a constriction at the lower end of the duodenum, between the root of the mesentery and the vertebral column. That this constriction can be brought about when traction is made on the mesentery by the small intestines hanging over the brim of the pelvis; that it is favoured by the dorsal position, a long mesentery, and a collapsed state of the gut. He gives the mortality as 72 per cent.

Treatment.—Treatment should be directed early to the relief of this condition. Indeed, if the case progresses far without recognition, the issue is almost inevitably fatal. Recourse must be had at once to the stomach tube, and the viscus must be emptied and washed out with an abundance of hot sterile salt solution. If, as is likely, the stomach begins quickly to refill, the tube must be again passed, and if necessary be left in for several hours.

In my own few cases, relief has always been given by changing the position of the patient. He must be placed prone in bed, with a pillow beneath the pelvis. One acts upon the supposition that there is compression of the duodenum by mechanical traction upon the superior mesenteric vessels. Whether the hypothesis be right or wrong, relief is undoubtedly afforded, sometimes in a most remarkable manner, by the change of posture. In the severer instances opening and drainage of the stomach may be necessary; or the operation of gastro-enterostomy may be considered.

Phlebitis and Thrombosis.—The occurrence of thrombosis of veins is not very infrequent after any form of abdominal operation. It follows most commonly upon pelvic operations, especially abdominal hysterectomy, but also after operations involving the upper part of the abdomen, such as gastro-enterostomy or cholecystotomy.

The thrombosis of the vein may be due to or may precede phlebitis. If thrombosis is the primary condition, which is probably very unusual, it is attributed to heart weakness, and consequent slowness of the blood current, impoverished condition of the blood as a result of long illness, or repeated hæmorrhages (the "marasmic thrombosis" of Billroth), and to an increase in the coagulability of the blood due to an excess of calcium salts.

In the very great majority of the cases, however, it is probable that phlebitis occurs first, and that the formation of a thrombus is secondary. The phlebitis is due, almost certainly, to in-

fection, though many of the recorded examples occurred when it is said that the wound remained aseptic.

A thrombophlebitis is dependent upon the quantity and quality of the circulating blood and the condition of the vascular endothelium. For coagulation to take place there must be fibrinogen and fibrin ferment. Fibrin ferment does not exist normally in circulating blood as such, but results from a combination of thrombogen and thrombokinase in the presence of calcium salts. Thrombokinase is probably produced from the breaking down of the blood-platelets or of the white blood-corpuscles. Under normal circumstances the vascular endothelium appears to be able to deal with small quantities of thrombokinase, but its ability to do so is diminished by injury to, or inflammation of, the blood-vessels, retardation of the blood current, sepsis, increase in CO_2 in the blood, by general conditions, such as chlorosis and the other anæmias, where the vascular nutrition is poor, and by the specific fevers.

The etiology of thrombophlebitis is still as obscure as it was twenty years ago.

Clinically, thrombosis may occur in cases of acute or chronic inflammation of the vascular endothelium after trauma, in conditions where there is marked slowing of the blood stream, in cases of cardiac weakness, in the anæmias, or following infection.

This complication is found most frequently after abdominal hysterectomy (30 per cent. of the cases). This is an operation in which there are many ligatures left behind, a septic cavity is opened, and no drainage is provided. During an interval operation for appendicitis, there may be disturbance of those veins in the mesoappendix in which clots have already formed in the earlier stages of the disease. We know now that many of the wounds which run an "aseptic" course really contain organisms throughout the time of their healing. Infection, therefore, as a cause of phlebitis, cannot be excluded. To me it is the most likely explanation in all cases, though I quite rec-

ognise that a contrary opinion to this is held by surgeons of considerable authority, such as Maurice Richardson and others.

The veins most frequently affected are the saphenous and femoral of the left side. The enormous preponderance of the cases on the left side has never been adequately explained. Dr. W. W. Keen suggested that the passage of the left common iliac vein under the right common iliac artery might lead to a retardation of the blood in the left vein, and thus act as a cause of venous thrombosis. This anatomical arrangement doubtless plays some part in the causation of the condition, and it is well to note also that when there is any congenital anomaly in the venous system below the diaphragm, it is almost invariably found upon the left side. Varicose veins of the lower extremity are far more frequent upon the left side than the right. But it is doubtful whether the merely mechanical conditions which can be brought about by any of the circumstances mentioned would suffice to determine the so frequent incidence of the inflammation upon the left side.

We may summarise the main facts with regard to thrombosis following abdominal operations in this way: Thrombosis occurs most frequently after operations upon the lower part of the abdomen; it is estimated to happen in 2 per cent. of all cases; it is first noticed about two weeks after the operation; it is more apt to afflict patients who are debilitated by long illness, or whose condition is poor as a result of frequent hæmorrhages; it is found in great preponderance upon the left side, where it affects the saphenous and femoral veins; as a causative factor sepsis can rarely be excluded; phlebitis precedes the thrombosis, as a rule.

Cordier ("Journal of the American Medical Association," vol. ii, 1905, p. 1792) has collected records of 232 cases. He gives the following table, which shews the number of cases following various operations:

Nephrorrhaphy	9
Appendicitis, mostly so-called aseptic cases	27
Cholecystotomy	4
Oöphorectomy (cystic, cirrhotic, etc.)	16

Hysterectomy fibroids, so-called aseptic cases.....	69
Vaginal operations, character not stated.....	8
Alexander's operation.....	3
Hernia.....	4
Pyosalpinx.....	7
Pelvic operations, not specified.....	9
Abdominal and pelvic, character not stated.....	56
Ectopic pregnancy.....	4
Vaginal hysterectomy for cancer.....	9
Suspension of uterus.....	7
Splenectomy.....	1

SPECIAL FEATURES.

- In 213 cases, left saphenous or femoral veins were affected.
- In 8 cases, both left and right veins were affected.
- In 11 cases, right veins alone were affected.
- In 182 cases, proximal part of vein first affected.
- In 36 cases, distal part of vein first affected.
- In 14 cases, portion of vein affected not mentioned.
- In 166 cases, sepsis was not present at time of the operation.
- In 56 cases, no mention of sepsis or asepsis was made.
- In 10 cases, there was pus present at time of operation. In the great majority of cases the first symptoms appeared from the 10th to the 15th day.
- In 6 cases, pleuritic and lung complications.
- In 3 cases, sudden death occurred.

Cordier gives a good description of the clinical course. He writes:

"The usual onset of this condition is marked by a gradually increasing pain along some portion of the long saphenous vein, usually the left, and most frequently just below the saphenous opening in the fascia lata. This pain may extend along the whole course of the vein and, as a rule, does follow the vessel below the knee. An elevation of temperature of from 2 to 3 degrees is noticed and a proportionately increased pulse-rate is also observed. The pain in limb is increased by moving the limb or by permitting it to remain in a dependent position, and is partially relieved by elevating the leg and thigh. On examining, in many cases, there will be noticed a redness along the course of the inflamed vein or veins. If seen early, no perceptible swelling of the limb will be noticed, but within a few days, if the case is a severe one, the whole limb will be swollen, but more particularly the calf of the leg. This swelling is uniform, and free from discolorations or redness; in fact, the surface is blanched. Pressure along the course of the vein elicits tender-

ness, and in the calf of the leg the tenderness is found all over the posterior surface. The vein is hardened and rolls under the fingers like a tendon, in many cases. Pressure, if continued for several minutes, may produce pitting, but not so well marked as in the dropsical affections. Except along the course of the superficial portion of the vein, which may feel unnaturally warm, there is a death-like temperature of the surface to the examining hand."

Grant ("Jour. Amer. Med. Assoc.," 1907, i, 567) has published a report embodying the opinions of 30 American surgeons with regard to post-operative thrombosis in the lower extremities. Amongst the various hypotheses put forward, bacterially infected blood, recumbent posture, the anatomical situation of the vein and the quality of the blood are said to be the most important.

E. H. Beckman ("Annals of Surgery," 1913, i, May), reporting on the complications following 5835 surgical operations in the Mayo Clinic in 1912, writes under the head of Thrombophlebitis: "The total number of cases having a phlebitis as a complication following operation was 16. Although we continually have a certain number of phlebitis cases following operation, we have not been able to determine any causative factor in this annoying complication. We have always taken a middle course, so far as getting the patients out of bed early is concerned. Most laparotomy patients are kept in bed from eight to twelve days, except those having simple appendicectomies, who are allowed to get up on the sixth or seventh day following operation. It will be seen from the following table that exactly three-fourths of these cases of phlebitis were in the left femoral or internal saphenous vein and one-fourth in the right. None were double. This is about the usual proportion in our Clinic.

It has not been definitely determined that patients that have an infected wound or are infected at the time of the operation are more susceptible to phlebitis than so-called clean cases. We are often surprised to find a phlebitis develop in a patient who has

otherwise had an ideal convalescence. In only one of the present series was there an infected wound.

Appendectomy	1 left	1 right
Appendectomy, curettage and perineorrhaphy . . .	1 left	..
Cholecystostomy, internal Alexander; curettage . .	1 left	..
Drainage of pelvic abscess	1 left	..
Total abdominal hysterectomy	1 left	1 right
Gastrectomy	1 left	..
Cholecystostomy and appendectomy	1 left	..
Cholecystectomy	1 left	..
Kraske; colostomy	1 left	..
Tube and ovary, appendectomy	1 left	..
Ovarian cyst	1 left	..
Mayo's operation for prolapse	1 left	..
Ventral hernia . . . . .	..	1 right
Cholecystostomy . . . . .	..	1 right
	<hr/> 12	<hr/> 4"

L. B. Wilson ("Annals of Surgery," Dec., 1912) gives a statistical record of all the cases of fatal post-operative embolism occurring in the Mayo Clinic during the years 1899-1911 inclusive.

During these twelve years 63,573 major operations were performed, with 47 cases of fatal post-operative embolism. Autopsies were made in 41 of the fatal cases.

The total number of deaths from all causes was 864, of which the fatalities from embolism represent 5 per cent.

The total mortality from embolism was therefore 0.07 per cent.

After 1372 operations on blood-vessels	2 deaths, or 0.14 per cent.
After 3266 operations on the thyroid	2 deaths, or 0.06 per cent.
After 2281 operations on the mouth	1 death, or 0.05 per cent.
After 2391 operations on the stomach and duodenum	3 deaths, or 0.12 per cent.
After 4597 operations on the gall-bladder	9 deaths, or 0.19 per cent.
After 389 operations on the small intestine	1 death, or 0.26 per cent.
After 9908 operations on the appendix	4 deaths, or 0.04 per cent.
After 2530 operations on the colon and rectum	5 deaths, or 0.02 per cent.
After 4501 operations for hernia	5 deaths, or 0.11 per cent.
After 900 operations on the kidney	1 death, or 0.11 per cent.
After 601 operations on the prostate	4 deaths, or 0.66 per cent.
After 7993 operations on the uterus, tubes, and ovaries	10 deaths, or 0.13 per cent.

Of the 47 cases, 25 were males and 21 females; the youngest was twenty-five and the oldest seventy-two.

19 of the fatalities occurred within the first week.

21 of the fatalities occurred within the second week.

4 of the fatalities occurred in the third and one each on the twenty-sixth, thirtieth, and sixty-fourth days.

In 36 cases the embolism was pulmonary, in 10 cerebral, and in 1 coronary.

In 28 of the 41 cases examined post-mortem the location of the primary thrombus was in the field of operation or in the femoral veins; in 4 cases the emboli were probably cardiac; in 9 cases the seat of origin was not determined.

Summing up, Wilson writes:

"The most important factors concerned in extensive post-operative thrombosis are as follows:

"(a) Injury to the vascular walls. Rupture of the intima by cutting, ligaturing, or clamping causes a rapid deposit of a fibrinous thrombus, which, however, is normally confined to an area close to the injury. Over this the endothelium quickly extends, covering the thrombus within a few days. It is probable that such small terminal thrombi, when covered by endothelium, rarely, if ever, become detached and form emboli. There can be no question, however, but that the constantly present small thrombi in injured vessels form a nucleus for the subsequent development of large, loose thrombi through the activity of other factors.

"(b) Slowing and stagnation of the blood stream. After operations the rapidity and volume of the current in the veins are materially lessened for a considerable distance proximal to the first incoming venous radicles. Furthermore, the patients are usually kept quiet in a recumbent posture, thus reducing the force and rapidity of the heart's action and causing a general slowing of the blood current throughout the entire vascular system, including the heart. When the blood stream is slower or when a part of the vascular system is incompletely filled, a disarrangement of the blood-cells occurs, the white cells and platelets reaching the periphery of the stream and tending to attach themselves to the vascular walls. . . .

"(c) Disintegration of the corpuscles of the blood from toxic substances.

"While such toxic substances are not definitely known, their

presence is assumed from their apparent action in the severe secondary anæmias and hepatic diseases. It has been suggested that this factor may account for the high percentage of post-operative emboli following operations on the gall-bladder. It has also been suggested that toxic substances reaching the circulation from extensive carcinomata may in this manner cause marked post-operative thrombosis. In this connection, however, we must not forget the rarity of post-operative emboli following extensive operations for mammary carcinomata.

“(d) Bacteræmia. That bacteria and their toxins are the chief causes of extensive post-operative thrombosis as well as thrombosis occurring in the course of infectious diseases is now fairly well established. By no means all post-operative thrombi occur in the field of operation. Phlebitis and a resulting thrombus are all too frequent. The last decade has seen a very marked extension of our knowledge of the frequent infection of the blood stream by bacteria. This is particularly so in chronic diseases with local infection. It is readily conceivable that bacteria within the blood stream may have their virulence sufficiently reduced to prevent their setting up a local phlebitis until aided by operative traumatism of the intima, post-operative slowing of the blood current, or perhaps even the effect of a prolonged general anæsthetic on the leukocytes.”

As soon as the condition is discovered it must be treated very seriously, and the patient warned of the risks of disturbance of the limb.

The affected limb should be elevated on a couple of pillows, and some warm and comforting dressing applied. Lead and opium lotion, or warm boracic fomentations, are soothing and grateful to the patient, but they must be applied without disturbing the limb. If a long many-tailed bandage is placed from the buttock to the heel, the front and sides of the limb can be exposed, and the fomentations applied to them without moving the leg. Flannel bags loosely filled with bran, and made hot in the oven, keep warm for a couple of hours; they may be laid over a thin wrap of gamgee tissue and changed as often as necessary, without any disturbance.

Local treatment must be continued so long as there is tenderness in the course of the vein, and the first movements must be made with great gentleness and caution. It is not possible to fix arbitrarily any time for the commencement of movements, but in most cases four or six weeks must be allowed to elapse from the time when the last extension of inflammation occurred, before movement is permitted.

Lennander suggested some years ago that, in cases where thrombosis of the veins was feared, the patient should be kept in the Trendelenburg position for a few days. It is certainly an advantage in some cases slightly to elevate the foot of the bed, and to instruct the nurse to gently rub the patient's legs from the heel upwards for a few minutes two or three times daily.

Stasis and sepsis, probably the twin causes of phlebitis, are both preventable. The latter is perhaps not under our control so completely as we think, but the former can always be counteracted. In some six or seven cases of phlebitis following suppurative appendicitis I have used the intravenous injections of collar-gol with a degree of success which will urge me to use it in like cases in the future.

The possibility of detachment of a part or the whole of the thrombus must never be forgotten or minimised. Sudden death has occurred upon the patient first attempting to stand, or to move in his chair, as a result of pulmonary embolism.

The question of the association of thrombosis with post-operative pneumonia and pleurisy is discussed elsewhere.

CHAPTER IV.

ABDOMINAL INCISIONS.

I do not think that, though much thereon has been written, it is yet adequately recognised that the steps in the making and in the repair of an abdominal wound are of the very greatest importance. I doubt whether it is any exaggeration to say that the circumstances connected with the incision are among the most important in the whole range of abdominal surgery. For, if the incision be improperly made, by the free division of muscular fibres or the wilful and unnecessary severing of nerve-trunks, a weakened area is left in the belly-wall the results of which may be of even greater severity than those conditions which first made the operation advisable. Too great care cannot therefore be exercised in the proper choice of a method of incision and of the means of its securest closure. It is a cardinal rule that there shall be no division of muscular fibres unless it is absolutely necessary for a sufficient exposure of the operation field; muscular fibres are always to be separated, never to be cut. Nerves, likewise, are things to be treated with respect, and in many cases a little tact in the arrangement of a wound will result in the avoidance of any injury to them. As an example of the damage that may result from nerve division, I may quote the case of a patient upon whom an abdominal nephrectomy had been performed through the right linea semilunaris; several nerves had been divided, and, as an inevitable consequence, the rectus muscle supplied by them had wasted to the point of almost complete disappearance. An enormous hernia had developed, which no operation could possibly cure. In some instances

when the fibres of the rectus have been split in the performance of cholecystotomy or gastro-enterostomy, without reference to the position of the nerves, that part of the muscle to the inner side of the incision has undergone atrophy, and a hernia has consequently developed. At Czerny's instance Assmy investigated the after-results of cases in which a wide vertical splitting of the rectus fibres had been performed, and shewed that an atrophy of that part of the muscle dissociated from its nerve supply always followed. In cases of gastro-enterostomy, therefore, and in the operation of gastrostomy as performed by Hartmann and Kocher, the rectus muscle is not split at all. The anterior sheath is divided, the whole of the muscle is pulled to the outer side, and an incision is then made through the posterior sheath, on a line directly behind the skin incision. When the operation is completed, the muscle falls back into its normal position.

The splitting of muscular fibres is readily and safely accomplished in the operation of gastrostomy, as was first shewn by Howse; in the operation of removal of the appendix, as was shewn by McBurney; in the operation of removal of the kidney, as was shewn by Edwards, and later by Abbé; in the operation of left inguinal colotomy, and so forth. If, in any incision, a division of fibres can be effected in only a part of the wound, it is to that extent an advantage over an extended division of the fibres.

The principles which guide the surgeon in the making of incisions elsewhere must guide him here also. The cut must be perfectly clean; the edges of the muscle when separated or divided must be sharply defined; there must be no fraying of the edges, due to clumsy or untidy work. Furthermore, any rough handling of the wound during intra-abdominal manipulations must be expressly avoided. If a difficult manipulation is performed through an opening

which cramps the surgeon's hands, the wound edges will be bruised, perhaps soiled with escaping fluids; indeed, so great damage may be done that a proper healing of the wound is impossible. All incisions must, therefore, be of adequate, though never of undue, length, and as soon as the abdomen is opened a protection to the lips of the incision must be afforded by a covering of flat swabs, small linen squares, or other soft material which has been thoroughly sterilised and wrung out of hot sterile salt solution.

Wounds heal more kindly the greater the respect with which they are treated. I feel sure that some of the cases in which a stitch abscess seems incapable of explanation may be accounted for by the fact of rough handling and bruising of the cut edges of the wound. The method of incising the peritoneum between a

Fig. 19.—Incision of the peritoneum. The clip is held by the assistant, the dissecting forceps by the surgeon.

clip and a pair of forceps is shewn in figure 19, the slitting up of the peritoneum on the forefinger in figure 20.

The special incisions used in each region will be discussed in detail in each section.

In the **suture of incisions** great care is also necessary. When muscular fibres have been separated and pulled forcibly apart, the moment the retractors are withdrawn the fibres come together and close the temporary gap. How strongly

the muscles act in securing the closure of such a wound can be realised if the finger happens to be therein when the patient is straining, vomiting, or coughing. The finger is gripped in a sort of vice. Nevertheless I usually put in one or two sutures, uniting the separated edges, to ensure perfect accuracy of apposition. When a muscle is divided—say, the rectus

—or an incision is made in the middle line, the wound should always be stitched up in layers. I generally use three layers of sutures passed in the following manner:

A Hagedorn needle armed with a long thread of No. 2 catgut is used; the first stitch is taken at the top of the wound, and picks up the peritoneum and the fascia transversalis and the posterior sheath of the rectus, above the umbilicus; this stitch is continuous and extends from the top to the bottom of the wound. The needle is then laid aside,

Fig. 20 — Division of the peritoneum.

to be presently resumed. A series of silkworm-gut sutures are now passed through all the thickness of the abdominal wall which is not embraced by this first catgut suture; that is to say, that the skin and subcutaneous tissues, the anterior sheath of the rectus, and the bulk of the muscular fibres of the rectus are all included. A series of these stitches are passed, at intervals of about three-fourths of an inch, along

the full extent of the wound, using the transverse scratches marked on the skin with a needle, before the incision was made, to ensure accurate apposition. The ends are left loose on each side, and are there seized by a clip. These interrupted silkworm-gut sutures being introduced, the needle armed with catgut just laid aside is taken up again. The same suture, without knotting or

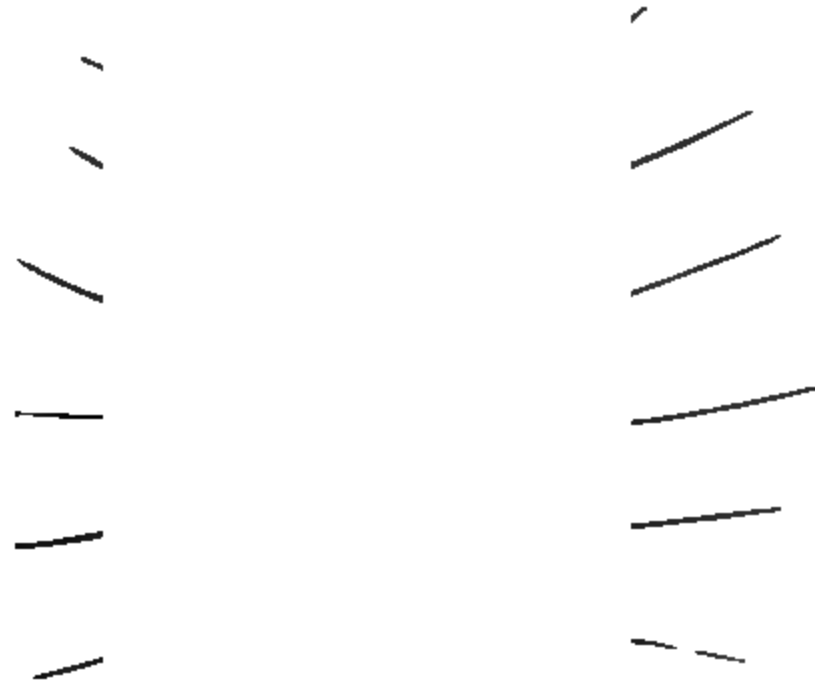


Fig. 21.—Suture of abdominal wall, shewing the continuous suture of catgut.

Fig. 22 —The interrupted sutures of silkworm-gut.

interruption, then returns from the lower end to the upper, picking up the anterior sheath of the rectus and a few of its muscular fibres. This stitch is pulled with sufficient tightness to get a good apposition of the anterior sheath of the rectus. When the upper end of the wound is reached, the end of the stitch is tied with the original end which had been left long, and the ends are cut short. The condition on section is shewn in figure 24.

The interrupted silkworm-gut sutures are now threaded through pieces of fine rubber tubing cut to the correct length, tied, and cut short. The rubber "bridges" prevent the deep tension



Fig. 23.—Suture of abdominal wall, the continuous suture returning and picking up the anterior sheath of the rectus.

Fig. 24.—Suture of the abdominal wall. Section shewing the position of the stitches: *a* and *a* are the different parts of the same continuous suture; *b, b*, interrupted sutures.

sutures from cutting into the skin and marking it. For the exact apposition of the skin edges I have frequently used Michel's clips.

In some cases where the abdomen is very lax there may be need of a slight overlapping of the cut edges of the anterior sheath of the rectus. It has been shewn that the greater part of the strength of the scar lies in the anterior sheath of the rectus; if good healing is obtained in that, the cicatrix is not likely to yield. The overlapping adds greater strength, therefore, to the scar. The methods of securing this overlapping are shewn in the figures.

With regard to the material which is used for the buried suture, nothing can be better than medium catgut adequately sterilised. The use of silk for buried stitches, though advocated by Kocher, possesses no single advantage over catgut, and it, questionless, possesses more than one disadvantage. The fallacy which supposes that a non-absorbable suture continues its functions perpetually has been exposed times without number. The wandering of such sutures away from the place of their introduction is a matter of common observation. If, therefore, they cease after a time to perform their necessary functions, they are, for their purpose, less to be commended than sutures which, having achieved their purpose, disappear. The weight, both of argument and experience, is, so far as I can ascertain, entirely on the side of those who use catgut rather than a non-absorbable material for their buried sutures.

Fig. 25.—The overlapping of the aponeurosis of the rectus in the suture of an abdominal wound (Noble's method).

The method of suture of the wound just described has been found to give perfectly satisfactory results. It possesses the advantage of giving easy and accurate apposition to all the

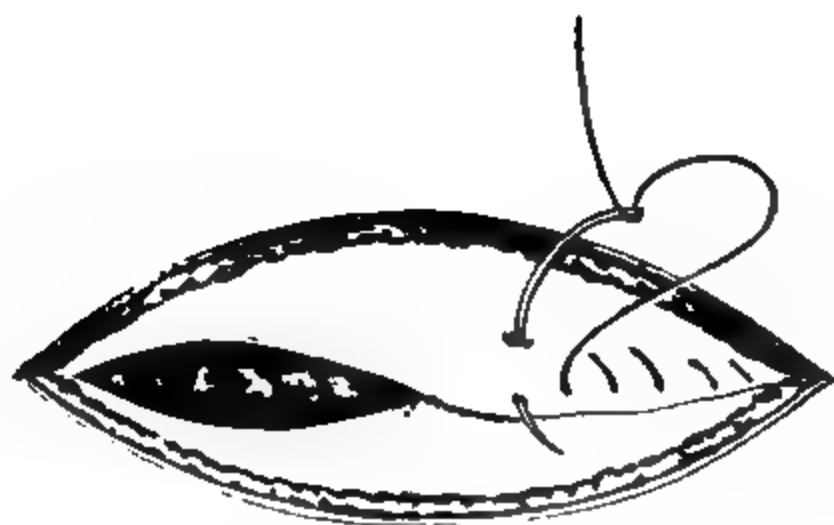


Fig. 26 --Overlapping of the aponeurosis in closure of abdominal wounds. The method of passing the needle is shown in the diagrams.

layers of the abdomen, and it especially supports the aponeurosis of the rectus, in that through this structure there are sutures of apposition and of wider support.

To obtain clean and perfect healing and permanent strength in the wound, it is necessary, therefore, to have

- (a) clean-cut, neat incisions,
- (b) an absence of teasing or fraying of the muscle edges,

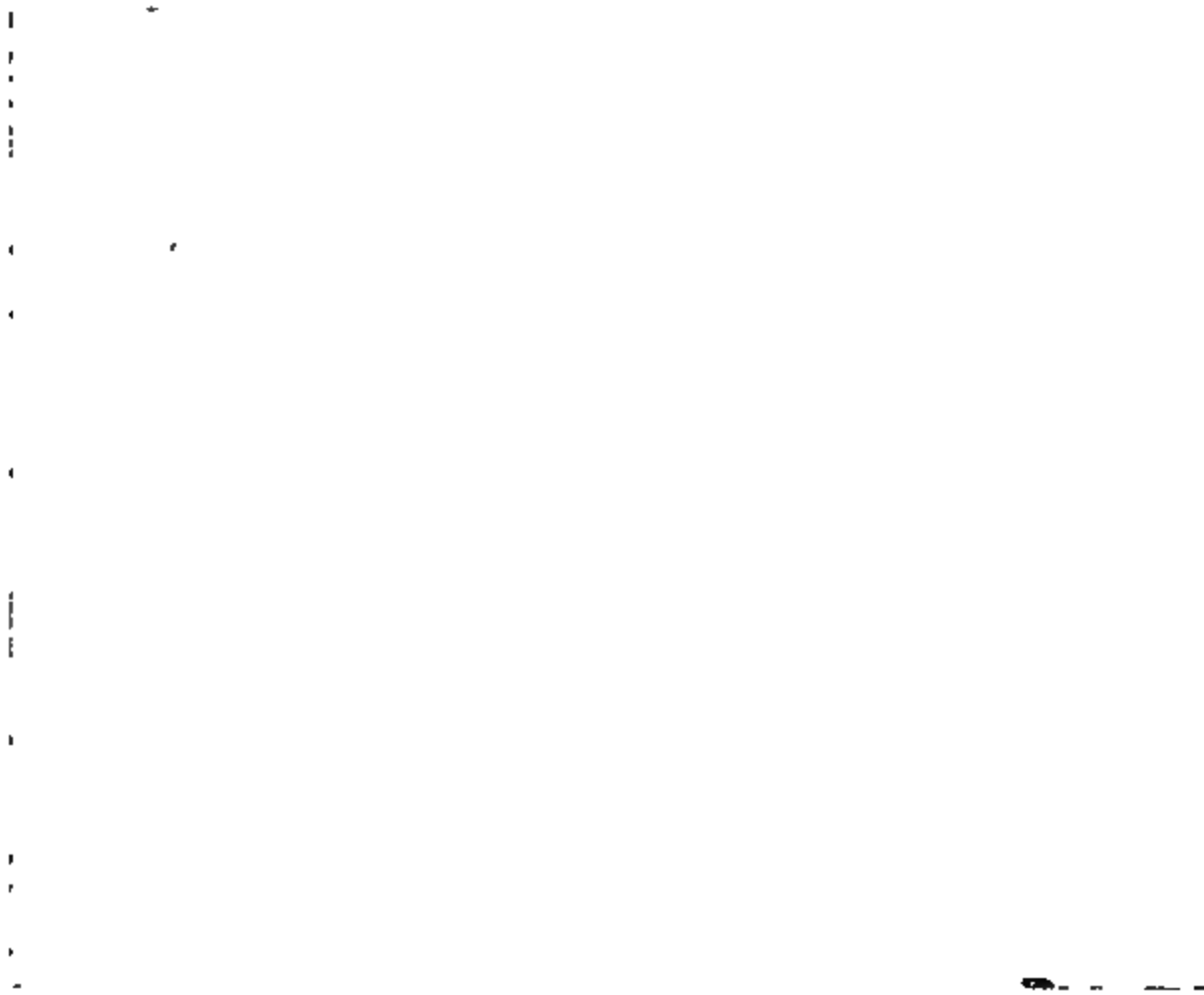


Fig. 27 — Method of holding a curved needle

- (c) protection to the lips of the wound from damage by instruments, hands, or discharges,
- (d) perfect asepsis throughout,
- (e) accurate suturing in layers, sutures of apposition and sutures of support both being used,
- (f) an absence of tension in the wound.

CHAPTER V.

PENETRATING WOUNDS OF THE ABDOMEN.

A DISTINCTION has been drawn between penetrating and perforating wounds of the abdomen, but the distinction is, for clinical purposes, negligible, for, in the great majority of instances, complete penetration of the abdominal wall implies also a perforation of some viscus. The wounds in which the greatest damage to viscera is inflicted are generally below the umbilicus.

The viscera are injured in the following order of frequency: the small intestine, the liver, the stomach, the large intestine, the other solid viscera. As soon as the intestine is wounded, if the wound is small, there is a prolapse of the mucous membrane, which temporarily blocks the opening and prevents a discharge of the intestinal contents. It is generally supposed that the leakage of the contents occurs instantly upon the solution of continuity in the bowel, but this is not the case. A temporary sealing is the rule. The two conditions which aid in extravasation are intestinal distension and the manipulations of the surgeon. When the injury is inflicted upon the intestine, the damage is of such a character as to cause a local stunning or paralysis of the bowel; movement is, therefore, arrested, and the pouting of the mucosa temporarily blocks the opening. When distension occurs, and when the power of movement returns, then leakage may occur. Murphy has pointed out forcibly that extravasation occurs chiefly on manipulation. When the solid viscera or the mesentery are wounded, hæmorrhage occurs, often in profuse quantity.

Douglas writes:

"The effects of any given penetrating wound of the abdomen are problematical. Their nature is uncertain; the tract is always septic; the number of perforations, unknown; complications cannot be foretold. If a ball of average velocity enters the abdominal cavity, perforation is to be expected. That it may find its way between the interstices of the intestines we have previously admitted as a possibility; but that it may produce perforations of the intestines from one to twenty-eight in number is a recorded fact; that, if solid viscera lie in its course, it will traverse these and, in all probability, will wound other viscera. Multiple perforations occur most frequently in the ileum, and are oftenest made by bullets that pass through the abdomen obliquely from side to side."

The following is the method of operating: The abdomen is opened through a median incision under all circumstances—lateral incisions must not be used, for some part of the necessary investigation cannot be conducted through them.

The escaping blood-stained discharge is cleared away as speedily and completely as possible, and if there is evidence of hæmorrhage occurring at the moment, the solid viscera, liver, spleen, kidneys, and the mesentery, must be first examined. If injuries thereof be found, they must be dealt with forthwith, for injuries of the hollow viscera are far less urgent in their need for attention.

Wounds in these viscera may be treated by suture, by cauterisation, or by packing with gauze. The liver and the kidney both hold sutures well; the spleen generally tears away under the tension of a stitch. In extensive wounds of either spleen or kidney the organ may have to be excised. The sutures used for the control of the hæmorrhage are passed with an ordinary large intestinal needle, or, in the case of the liver, by Kousnetzoff's special instrument. If the kidney be injured, posterior drainage is needed.

The solid viscera having been dealt with, the intestine

must be methodically examined. Starting from a fixed point,—the duodenojejunal flexure or the cæcum,—the whole of the small intestine is rapidly passed through the fingers, and, as a rent is exposed, it is at once sutured. Two or three rents may lie close together, but if so, it is better to suture them than to excise the damaged length of gut. Resection is at times necessary, but it should be adopted only when simple suture is impossible. As a rule, there is no need to turn the intestines out of the abdomen, but this may be done if necessary.

As the bowel is examined, the mesentery is carefully searched for a wound. If one of small size be found, it may be closed with a single suture. If there be a large one, parallel to the bowel, the segment of gut supplied by the torn vessels will have to be excised. All rents in the intestine are closed by a double layer of sutures in the usual way.

Other organs are now examined—the bladder, large intestine, pancreas, etc.—with equal care. Though a detailed examination of all parts is tedious and time-consuming, it cannot be neglected with impunity. Disaster follows perfunctory work.

Lavage and drainage are adopted in the manner and under the circumstances already described. It is safer always to drain.

The experience of surgeons in America is far greater in this matter than that of any European surgeon. I cannot, therefore, do better than quote from Dr. Douglas's admirable work on "The Surgical Diseases of the Abdomen" the following paragraph on the general surgical indications in cases of gunshot wound of the abdomen:

"The indications in any given case of gunshot wound of the abdomen are to relieve shock, control hæmorrhage, remove infectious matter, re-establish the continuity of the injured viscera, and provide direct or indirect drainage. If the patient is in great pain, a hypodermatic injection of morphin should be immediately given, and he should be moved

with greatest care to his home, or preferably, to a hospital. Preparations should be in progress for an abdominal section. Stimulants may now be indicated. If penetration is not obvious, this question should be determined by enlarging the wound of entrance under cocain anæsthesia. If penetration is found, or if, from the location of the wound, course of the bullet, and the symptoms, it seems at all probable, a general anæsthetic, preferably ether, is administered, and laparotomy at once undertaken. The abdomen is opened through the linea alba preferably, as the track of the bullet is always septic. The location of the wound and known course of the bullet may justify lateral opening. When the peritoneum is opened, if there has been much hæmorrhage, its free escape intensifies the existing shock. To overcome this, the assistant, who has previously exposed a vein and introduced a cannula, now proceeds with the intravenous infusion of normal saline solution, the surgeon having by this time secured the principal bleeding points, which is the first indication on opening the abdomen. If, while searching for these, he meets with intestinal perforations, they should be surrounded with gauze to mark them and to prevent extravasation. The increased vascular tension due to the saline infusion will develop bleeding points which might otherwise escape notice. This known action of the saline prohibits its use until the abdomen is opened and the chief bleeding points are controlled. Our methods of hæmostasis are ligature, suture, actual cautery, and gauze packing. The next step is to repair the injured viscera by the special methods which will be emphasised under their several headings. Unless there has been widespread extravasation of visceral contents, the peritoneal cavity should not be flushed, but all material removed by gentle sponging with gauze. After the intestinal perforations are closed, an ounce of saturated solution of sulphate of magnesium should be introduced through a cannulated needle into a coil of the intestine remote from the wound, and this puncture closed by suture. The question of drainage in gunshot wounds of the abdomen is *sub judice*. Tiffany, Coley, and, indeed, the majority of surgeons, advise drainage in all cases in which viscera are injured. Fenner's personal experience in 6 cases with 5 recoveries and 1 death, all treated without

drainage, and my own experience in 8 cases with 2 deaths, lead me to the conclusion that drainage is not desirable if there is little or no extravasation and if the operation has been done within six hours. In operations after that time and in all cases where the general cavity has been irrigated multiple gauze drains should be employed. The bullet wound in the parietes, either of exit or entrance, should be excised and closed by sutures or left open and drained with a strip of gauze."

Dr. Fenner ("Annals of Surgery," vol. xxxv, p. 15) reports six cases of penetrating wounds of the abdomen treated by operation, and gives statistical tables of 152 cases treated at the Charity Hospital, New Orleans, between January, 1892, and January, 1901. There were 96 cases of gunshot wound of the abdomen with visceral injury. Of these, 71 died—a mortality equivalent to 73.95 per cent.

This subject is discussed further in the chapters dealing with the injuries of the several viscera.

CHAPTER VI.

THE SURGICAL TREATMENT OF ACUTE PERITONITIS.

CASES of acute peritonitis may be classified into three groups:

1. Those in which the inflammation is localised, and an abscess, definitely and sharply separated from the rest of the peritoneum, is present.
2. Those in which the peritonitis is spreading away from the original source of infection, but in which some part of the peritoneum is demonstrably healthy.
3. Those in which the affection of the peritoneum is universal.

The following remarks apply to the last group. The principles of treatment in the first and second groups are dealt with elsewhere.

OPERATION IN ACUTE PERITONITIS.

In cases of acute general peritonitis operation is indicated, *firstly*, for the purpose of giving vent to the products of inflammation—pus, sero-pus—and the escaped contents of wounded viscera; *secondly*, for the purpose of removing, or of otherwise dealing with, that organ or viscus from which the inflammation originally started; *thirdly*, for the purpose of cleansing, so far as is possible, the walls and recesses of the infected cavity; *fourthly*, for the purpose of emptying, and if need be draining, the intestine whenever it is paralysed in over-distension; and, *fifthly*, for the purpose of providing for a further discharge by free drainage (which can only be of a temporary character), or for shutting off by gauze packing the most infected part of the cavity. I do not think that in any abdominal operations ever undertaken by the surgeon the need for speed, com-

bined with aptness, can be greater than in these. Slow operations mean death from shock; imperfect operations mean death from a continuance of the acute inflammation. Perfunctory work and slow work are both out of place.

It must be the surgeon's duty, therefore, to ensure that every precaution is taken to lessen or avoid the incidence of shock, and to see that absolutely everything needed in the operation is ready before the anæsthetic is administered.

As a rule, an enema of 10 or 12 ounces of warm water with an ounce of brandy and a hypodermic injection of 10 minims of liquor strychninæ will be given. The cleansing of the abdomen can generally be done before the ether is given. The abdomen is opened by a free incision in the middle line. As soon as the peritoneum is incised, the character of the escaping fluid is noticed. The fluid in the case of perforated gastric ulcer is generally turbid, abundant, and flakes of lymph or of food are floating in it. When the duodenum is perforated, the fluid may be bile-stained. In both, the gas, which is also present free in the peritoneal cavity, is odourless; this is a point of considerable diagnostic importance, for if the gas be of strong odour, perforation in the stomach or duodenum can almost certainly be excluded. If the fluid be darkish brown and offensive, a low perforation of the intestine will be suspected. In cases of typhoid fever in which an ulcer perforates the fluid is turbid, contains brownish material and particles of curdled milk or other food. The characters of the fluid are not always such as to give help to the surgeon. Pus may result from a variety of conditions, and its abominable offensiveness, though suggesting a perforation of the appendix more decidedly than any other lesion, is not pathognomonic.

The hand or three fingers are now introduced within the abdomen with the most scrupulous gentleness and care. The damage done by clumsiness now may be irreparable; the rough and forcible pushing of the hand indiscriminately within

the abdomen may rupture the thin and tender peritoneum tightly stretched over an inflamed intestine, and leakage of highly infective organisms through these rents may produce a fatal inflammation.

The search within the abdomen is purposeful. The cæcum is first sought, in order to ascertain the condition of the appendix, and in order to discover the condition, as to distension, of the cæcum itself. If the appendix be discovered to be gangrenous, it is dealt with at once in the usual manner. If the cæcum is found distended, it is clear that the lesion, if of an obstructive character, is in the large intestine. The sigmoid is then sought; if that too is distended, the condition (if the rectum be unobstructed, which, presumably, it is known by previous experience to be) is one of general paralytic distension of the intestine due to a universal inflammation. If a search has so far proved ineffective and the condition of the patient permits a further investigation, a close scrutiny should be made in order to discover any thick localised deposit of lymph. This, in the majority of instances, will lead to the discovery of the source of offence, for the first and instant response of the peritoneum to injury is the abundant outpouring of lymph and fluid. If it be noticed that though fluid is everywhere present a thick, "wash-leathery" deposit of lymph is confined to one area alone, in that area the perforation or other source of irritation may confidently be sought.

The primary disease having been discovered and having been dealt with as seems best, the question next arises as to the surest means of cleansing the peritoneal cavity. With regard to this matter there are still widely divergent opinions among surgeons of great experience. Some advocate the free universal flushing of the peritoneum; others are convinced that this is largely a measure of harm, and are content with gentle sponging, while still others rely solely upon the insertion of drains of rubber tubing.

By the paracostal incision where there are particles of food, which or a very turbid exudate is at once to make a second incision in what seems the most appropriate place for affording free drainage—in the case of the appendix the incision is made over the iliac fossa. Through this incision a piece of large rubber tubing attached to a funnel is introduced, and a free escape of the sterile salt solution is begun. If both renal pelves are affected and a copious deposit of pus is found in them, incisions are made into them from above the iliac crest. These and drainage in these places may serve to prevent a suppurative process. I frequently make three, and occasionally four free incisions into the abdomen, each large enough to take a rubber tube. It is impossible to drain the whole peritoneal cavity through a single opening—the difficulty, indeed, is to drain it adequately through many openings. Such drainage is only temporary owing to the rapid encapsulation of the pus. Thus the loss of it is of supreme advantage and importance.

It is necessary and that the lavage of the peritoneal cavity is largely made because the recesses and complexities of the peritoneum are such that no flushing, however carefully executed, can possibly clean out all the collections. I am inclined to doubt the accuracy of these observations. With a single rubber tube of good diameter, a free flow of sterile solution and easy means of escape by tubes introduced into other recesses, a reasonably complete cleansing is certainly possible.

It is the practice of many surgeons to leave as much fluid as possible in the peritoneal cavity. Whether much or little is left seems a matter of indifference, for if much be left, there is probably an easy escape for it within a very short time through the various

resorts, each holding its own drainage as a rule. I mop gently any specially infected part and thereby draw away all excess of fluid. A rubber tube is introduced when gauze swabs are introduced for

mopping purposes, is to be expressly avoided, for this rough friction probably does more hurt to the peritoneum than anything else.

As a rule, only the original incision needs to be sutured; the other openings are purposely made of a size no larger than is necessary for the easy introduction of the drainage-tube.

The making of the multiple incisions in this manner does not in the least weaken the abdominal wall, for the surgeon is careful to split through the muscles everywhere, and not to cut them rashly; and is careful, also, to avoid the section of nerves.

There are many surgeons of ripe experience who advise that in order to secure more complete cleansing of the peritoneum the whole intestine should be brought outside the incision, or at least well into the wound, loop by loop, and thoroughly cleansed by washing or wiping "with considerable force" the entire surface of bowel and mesentery. I have never carried out this advice, and I cannot think that it is one likely to advance the patient's chances of survival. It is a little too heroic.

J. A. Blake ("Amer. Jour. Med. Sci.," 1907, vol. i), in a paper on the treatment of diffuse suppurative peritonitis, has advocated a less universal adoption of peritoneal drainage in these cases. He lays down the following operative rules:

1. Remove as rapidly as possible through a small incision the origin of the inflammation.
2. Wash or irrigate the peritoneal cavity with a double irrigator.
3. Drain as little as possible, and do not attempt to drain the general peritoneal cavity.

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It is constantly said that the lavage of the peritoneal cavity is largely futile because the recesses and complexities of the peritoneum are such that no flushing, however carefully executed, can possibly clean out all the collections. I am disposed to doubt the accuracy of these observations. With a supple rubber tube of good diameter, a free flow of saline solution, and easy means of escape by tubes introduced into other incisions, a reasonably complete cleansing is certainly possible.

It is the practice of many surgeons to leave as much fluid as possible in the peritoneal cavity. Whether much or little is left seems a matter of indifference, for if much be left, there is probably an easy escape for it within a very short time through the various incisions, each holding its own drainage-tube. As a rule, I mop gently any specially infected part of the abdomen and empty away all excess of fluid. A rubbing of the peritoneum, when gauze swabs are introduced for

mopping purposes, is to be expressly avoided, for this rough friction probably does more hurt to the peritoneum than anything else.

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2. Wash or irrigate the peritoneal cavity with a double irrigator.
3. Drain as little as possible, and do not attempt to drain the general peritoneal cavity.

After the lavage has been completed he closes the incision, leaving a small opening for wound drainage. The drain simply passes through the wound, and just enters the abdomen, allowing the excess of the irrigating fluid to escape and preventing wound suppuration.

If deep drainage is necessary, owing to imperfect removal of the cause of the peritonitis, insecure closure of a perforation, or necrotic material, a suitable drain is carried down to the site in a manner similar to that adopted when there is no diffuse peritonitis. Blake writes:

“With regard to drainage, if after irrigating one can feel assured that there is nothing left in the peritoneum but what can be absorbed, there is no need of drainage. If there is something left which probably will not be absorbed, one should drain, but should only drain down to the doubtful substance.”

He gives the following statistics:

CASES OF DIFFUSE PERITONITIS DUE TO APPENDICITIS	
Deaths.....	15
Not drained.....	7
Drained.....	8
7 to stump of appendix, 1 to pelvis	
Recoveries.....	63
Not drained.....	31
Drain to stump of appendix.....	28
Drain to pelvis.....	4
Total.....	78
CASES DUE TO GASTRIC OR DUODENAL EXTRAVASATION	
Deaths.....	4
Not drained.....	2
Drain to suture.....	2
Recoveries.....	9
Not drained.....	4
Drain to suture.....	4
Drain to pelvis.....	1
Total.....	13
TYPHOID PERFORATIONS	
Deaths.....	4
Drained.....	3
Drain of pelvic abscess.....	1
Recoveries.....	4
Not drained.....	2
Drained.....	2
Total.....	8

A further point to be considered in all these desperate cases, when distension, even to paralysis of the gut, is present,

has reference to the need for evacuating the contents of the intestine by enterotomy or enterostomy. There can be no question that in many cases a free evacuation of the stagnant gas and faecal material is entirely an advantage. The intestines are little likely to regain their power of contraction when distension has passed beyond a certain point, and when this power returns, there seems to be a return also of the rapidity of absorption of the intestinal contents. These are of an intensely toxic character, as we know by abundant painful experience and by the experiments of Kader. The emptying of the intestine should, therefore, be considered an almost routine practice. If carried out in the manner described elsewhere, with the help of a glass tube inserted into the bowel, upon which the gut is drawn, the emptying of the intestines is a simple, speedy, and satisfactory matter. The opening, of course, is made as low down in the intestine as possible. Lennander makes two or three openings in the intestines at various levels, establishing at each a "Witzel fistula." The lowest of these fistulae leads into the caecum, and is used, if need be, for administering liquid food by the colon.

Dr. Andrew McCosh has suggested—and I have frequently acted upon this important suggestion—that a large dose of sulphate of magnesia should be introduced into the intestine, high up, for the purpose of ensuring a return of peristalsis. Dr. McCosh (Intern. Soc. of Surgery, Sept., 1905) wrote: "Though I still employ this method I am less enthusiastic as to its value. Some surgeons, however, regard it with favour and I am still inclined to believe that it is often beneficial. If the source of the peritonitis has not been removed it of course should never be employed."

As soon as the patient returns to bed, he is propped up almost in the sitting posture. This is far more comfortable for him, allows drainage down towards the pelvis, and away from the diaphragm, and thereby lessens the risks of that most serious complication, subphrenic abscess.

B. H. Buxton ("Jour. Med. Research," Boston, March, 1907) has shown that bacteria, when injected into peritoneal cavity, even in minute doses, reach the circulation in a few minutes by way of the lymphatics of the diaphragm. If these results be applied to man, then the Fowler position is indicated to avoid a rush of bacteria toward the diaphragm and flushing the abdominal cavity is not indicated.

Of late years irrigation in cases of acute peritonitis is less frequently adopted than formerly. Surgeons have learnt the importance of respecting the diaphragmatic area, the risk of washing away phagocytes by indiscriminate irrigation.

Warmth should be freely applied to the patient; rubber bottles filled with hot water and swathed in flannel should be placed close to the body and extremities. Care is, of course, taken to ensure that the patient is not burnt by these. In many cases, especially if vomiting has been a troublesome and persistent symptom, the stomach must be washed out before the patient leaves the operating-table, and, if necessary, an ounce or two of hot water, in which some Rochelle salts or sulphate of magnesia is dissolved, is allowed to remain in the stomach. If vomiting persists after the operation, the stomach may again be washed out, with great relief to the patient.

If collapse occurs or deepens, the infusion of about 1½ to 2 pints of saline solution into the median basilic or other accessible vein will help the patient to rally. This may be repeated at the end of twelve to twenty-four hours if necessary.

I have used, with striking success in many cases, the method, introduced by Kocher, of continuous subcutaneous infusion. Two needles connected by india-rubber tubes and a Y tube, with a funnel, are introduced into the subcutaneous tissue, one into each thigh or one into each axilla. Normal saline solution is poured into the funnel and drains slowly into the tissue. About one pint in an hour is the best quantity to introduce. Care must be taken to keep the fluid at the proper

temperature (about 105° F. in the funnel). To the first pint of the saline solution (0.9 per cent.) may be added 2 to 8 per cent. of glucose and $\frac{1}{2}$ to 2 per cent. pure alcohol; subsequently, saline solution only is given. For many cases continuous rectal injection acts equally well, and it is easier to keep at the proper temperature.

The bowels should be encouraged to act as soon as possible by the administration of turpentine enemata or by the injection of glycerine.

Hypodermic injections of strychnine, say 5 minims every four hours, can often be given with advantage.

It is worthy of note that the method above described does not meet with universal sanction. There are surgeons who do not use the method of flushing the peritoneal cavity, being content with incision and drainage; and there are others who follow Dr. Joseph Blake, of New York, in his practice of free irrigation of the peritoneum without drainage.

Dr. Blake writes: "I was formerly a warm advocate of abundant drainage; later I became convinced of the utter impossibility of draining every part of the peritoneal cavity, for it was evident that the drains were soon isolated by adhesions, so I next confined myself to the drainage of the field of operation, and then, perceiving that the other similarly affected regions of the peritoneum took care of themselves, I omitted drainage almost entirely and only employed it when the presence of necrotic tissues or hæmorrhage demanded it."

My own practice in these cases is to ensure, as far as possible, cleansing by free lavage, free drainage, and, if need be, emptying of the intestine by enterotomy or enterostomy.

CHAPTER VII.

TUBERCULOUS PERITONITIS.

THREE forms of tuberculous peritonitis are recognised:

1. The ascitic or miliary form.
2. The fibrous form.
3. The suppurative (ulcerative) form.

It is of the first importance from the surgical point of view to bear constantly in mind the fact that the various forms of tuberculous peritonitis are *secondary*, and not *primary*, diseases. The invasion of the peritoneum occurs from some organ within the abdomen which itself has been attacked by a tuberculous process. Just as acute septic peritonitis is due to the spread of infection from some organ which has been first attacked (the appendix, for example), so in tuberculous peritonitis the peritoneal invasion starts out from some organ which has been primarily affected by the disease. The importance of this knowledge of the secondary character of the tuberculous process in the peritoneum, so far as concerns treatment, cannot well be exaggerated.

1. In the ascitic form the peritoneal cavity is filled with a clear serous effusion. The peritoneum, both parietal and visceral, is covered with small nodules, which are placed as close together as is possible. Wherever one looks or feels it is the same,—the peritoneum is thickly studded with fine rough granules. A piece of intestine, allowed to escape from the wound, shews a peritoneal surface that has lost all its smoothness and polish. The surface is rough, congested, red, and thickened. If carelessly handled, it is apt to bleed, or some of the outer coat may slither away beneath the finger. The fluid is free in the peritoneum, there are no loculi, and there are no adhesions, as a rule.

In a certain number of cases the deposit of tubercles may be so thick that a definite, palpable tumor may be formed. Thus the omentum may be an inch or even more in thickness, and it may be shortened and puckered upwards to the greater curvature of the stomach. The primary source of infection, a Fallopian tube, the appendix, an ulcer in the intestine, or a mesenteric gland, may be recognised or may be securely walled off in a mass of protective adhesions.

2. The fibrous form is comparatively rare. It is due to a similar deposit of tubercles to that already described, but there is a complete absence of serous effusion. The opposing peritoneal surfaces have everywhere become adherent, until, at the last, there is no peritoneal cavity left. However extensively adhesions are separated, adhesions still are met with. It is quite exceptional to find even a few drops of serous effusion.

In certain rare instances a combination of the conditions described above may be found. There is a localised cystic swelling whose walls consist solely of fibrous tissue, with a deposit of tubercles universally distributed, separating the fluid from the intestines which lie immediately outside. The peritoneal cavity elsewhere is obliterated by adhesions, and tubercles may be seen scattered everywhere. I have recently operated upon such a case,—a cystic tumour without pedicle enucleated from a bed formed by the intestines, which, in other parts, were so adherent that separation was impossible. Cystic swellings may develop in the pelvis of women and form tumors resembling ovarian cysts. Their walls are fibrous and thick, and into their cavity the patulous end of a tuberculous Fallopian tube will be found to open.

3. The suppurative form is found in those cases in which the tubercles, deposited in the peritoneum, have undergone caseation. As the result of a mixed infection, suppuration occurs. In such circumstances it is constantly found that the pus becomes localised. A general distension of the peritoneal cavity with pus is rare; the rule is to find one or more loculi completely separate one from another, each containing fluid. In all, the fluid may be

purulent, or pus may be found in one, and clear or turbid fluid in another. The visceral walls bounding an abscess cavity are often attenuated, even to such a degree that the gentlest handling may result in rupture. This form of the disease is more common in children.

The question as to the advisability or necessity for surgical treatment has excited great interest and frequent discussion. The opinion of surgeons is now almost unanimously in favour of operation in the ascitic form of the disease, and against operation in both the fibrous and the ulcerous forms. In the ascitic form the results, both immediate and remote, are good; the immediate results are, indeed, very often surprising. The patient almost at once makes haste to improve; he eats better, puts on weight, and his appearance improves almost beyond recognition. The permanent results are, perhaps, not quite so remarkable. After a period of the brightest health, the patient's vitality may flag; other deposits than that in the peritoneum may take on a great activity, and patches of disease in the lungs, or pleura, or the generative organs, may grow apace. This is especially the case when the primary source of the disease has been allowed to remain. If the abdomen has been merely opened, emptied of fluid, and closed, the primary source of infection, the Fallopian tube or the appendix, may continue to pour out its supply of active bacilli into the peritoneal cavity as it did before. The effusion reappears, and a second, or a third, or a fourth operation may be necessary. When, however, the primary disease has been removed, the results are very much more satisfactory. "Recurrence," so called, of tuberculous peritonitis, means continued infection.

Before reckoning up the advantages of surgical treatment in this disease it is necessary to recall the fact that tuberculous disease of the peritoneum tends not rarely to spontaneous recovery. Patients may remain ill from the disease for months, but under careful nursing, with generous but prudent feeding and a plentiful supply of fresh air, they may slowly return to

health. Borchgrevink comes to the conclusion that approximately one-third of all cases recover spontaneously or under careful medical treatment. This estimate is probably in excess of the truth, and it does not take into account the cases in which, after months or even years of apparent relief, the tuberculous process spreads to other parts and, by its increase, causes death.

The results of surgical treatment have been studied by many writers. Rorsch, writing in 1895, gave the result of his examination into the histories of 358 cases. Thirty-two patients died as a result of the operation; 51 patients died within eighteen months as a result of a recurrence of this disease, or of an extension of disease in areas affected before the operation was undertaken. The remaining 275 cases all shewed improvement; in 63 of these, over two years had elapsed from the time of the operation, and all these patients were in good health and free from obvious disease.

Wunderlich, in a series of 344 cases, found that 81 patients died as the result of the operation. Of the remainder, 80 patients had remained well for over three years.

Margaracci reported 250 cases of laparotomy in Italy with 85 per cent. of recoveries; Adossides, 405 operations with 75 per cent. of recoveries.

These lists undoubtedly include cases all of which were not suitable for operation. If those patients suffering from the ascitic form are alone treated by operation, the results will shew a permanently good result in at least 50 to 60 per cent. of cases. In Czerny's clinic 40 to 50 per cent. of cures are reported, and in recent years these results have been surpassed.

Operations performed upon patients affected by the fibrous form of disease are rarely productive of any good result, and some harm may undoubtedly be done by the attempted separation of adherent coils of bowel.

In such cases, the intestine may be wounded when the abdominal incision is made, for there may be a firm agglutination between the bowel and the parietal peritoneum.

In a few instances circumscribed pseudocysts may form between the adherent coils of intestine; often small, they may at times increase in size rapidly and come at the last to form cysts having a capacity of several pints. Such cysts have no walls other than the walls of the bowel around them; their removal is then impossible. When opened, they should be emptied, wiped out carefully, and not drained. As Murphy points out, these cyst-cavities are easily infected, and once infected they continue as suppurating sinuses for months.

The suppurative form of the disease is often secondary to a suppurative disease in the Fallopian tube or in the intestine. When treated by operation, the results are sometimes disastrous, for fæcal fistula may be caused by the gentlest handling of the bowel, or the gut, already weakened by disease, may burst, either at once or in a few days, into the abscess cavity after the pus has been allowed to escape.

There are cases, however, of localised suppuration which are rightly treated by operation. They are the cases in which a circumscribed cyst formation, as previously described, has occurred, and the suppuration is due to a mixed infection. These cysts should be opened, gently cleansed, mopped out with weak formalin solution, and closed. Murphy relates an extreme case of this kind. He writes: "In one of my cases there were no intestines except the descending colon and the rectum below the umbilicus, a firm diaphragm of adhesions having formed across the abdomen at the umbilical level. The peritoneum above this diaphragm was free from tuberculosis; below the diaphragm was one large empyema of the peritoneum. After opening and draining the cavity, this wall proved so dense and firm that there was very little contraction and the patient succumbed to the toxæmia of the mixed infection. The abdomen should have been closed after the exploration and repeatedly aspirated and injected with a solution of formalin-iodoform-glycerin."

To sum up: Surgical measures should be adopted only in

those cases of tuberculous peritonitis in which there is effusion of fluid into the general peritoneal cavity. In these cases a decided benefit results from the operation; the immediate effect is often remarkably good, and the number of cases in which a permanently satisfactory result is obtained is probably 50 per cent. of the whole. The fibrous and the suppurative forms of peritonitis are rarely suited to treatment by operation; operation in most of these cases almost certainly does harm rather than good.

It is certainly desirable that operation should be practised in an early stage of the disease, or at least should not be postponed until the patient has become so wasted and exhausted that the shock of the operation is likely to be serious. After a trial of general medical treatment for three to six months after the onset of a fluid effusion, surgical measures should certainly be advocated.

OPERATION.

The operative treatment of tuberculous peritonitis is due to Spencer Wells who, in 1862, opened the abdomen of a patient whom he supposed to be suffering from an ovarian cyst. Tuberculous peritonitis was found and the abdomen was closed. To everyone's surprise the patient rapidly improved after operation, and was soon cured of her disease. The first formal advocacy of laparotomy as a therapeutic measure is, however, due to König, in 1884.

The surgical indications in dealing with tuberculous peritonitis by operation are, as stated by Murphy:

1. To remove or shut off the source of supply of the tuberculous material; that is, to remove the primary focus of the disease.
2. To remove the products of the infective process from the peritoneum.
3. To increase the tissue proliferation for the encapsulation of the foci already present.
4. To avoid mixed infection.

The operation in the ascitic form of the disease is of the simplest character: The abdomen is opened in the middle line below the umbilicus, an incision of about four inches being made. Care is necessary when the parietal peritoneum is being incised, for the membrane is often greatly thickened, and a coil of intestine may chance to be adherent to its under surface. As soon as the peritoneum is incised, some fluid will escape. The fluid should be emptied as completely as possible; as soon as the flow from the wound has ceased, the edges of the incision are held apart and a sterile gauze swab is passed into the pelvis and into the kidney pouches, so as to mop up any fluid that lies there. In doing this all rough manipulation must be avoided; the peritoneum must be gently patted with the swab, and not rubbed by it. Friction will only start a slight but troublesome bleeding from many points.

In these manipulations it may become evident that the origin of the disease lies in some special portion of the abdominal contents in the Fallopian tube, intestine or appendix. If the surgeon feels assured of this, he should not hesitate to remove the source of offence, for a complete healing of the disease is then more likely to result. Resection of a diseased part of the intestine or short-circuiting may therefore be necessary. If the patient is a woman, it is well to place her in the Trendelenburg position as soon as the fluid is emptied away. A free examination of the pelvic organs is then possible, and an affected tube or tubes can be at once removed. In cases of the ascitic form of the disease an operation should not be considered complete which leaves unexamined any of those areas which are known to be commonly the primary sources of infection. In women undoubtedly the peritoneal inflammation is secondary to tubal disease in a very large number of cases, and in all such the affected tube must be removed. The very significant patulous condition of the fimbriated opening of the Fallopian tube should always be remembered. As Murphy has shewn, it indicates invariably the presence of tuberculous disease within

the tube. The exposure of the tube and its removal may be extremely difficult. The adhesions are so complex, the adherent bowel so thin and friable, that the utmost care is needed in detaching the tube. It may be that the anatomical landmarks are obliterated in a bewildering mesh of adhesions. The round ligament must then be sought at the internal abdominal ring and traced backwards to the uterus. Little by little, adhesions are separated with the utmost gentleness, until the tube is well exposed.

The cavity being rendered as dry as possible, the abdominal wound is closed by suture in the usual manner. Drainage should not be practised,—it is of no advantage, and it is not unlikely to do harm by causing adhesion of the drainage material to a piece of bowel which may subsequently give way.

Some surgeons advocate the introduction into the abdomen of iodoform; others, the washing out of the peritoneal cavity; others again, drainage through the vagina in the female. All these are unnecessary. Simple opening, emptying and closing of the abdomen, with removal of the primary focus, are all that are necessary to ensure success; and, throughout, the utmost gentleness is needed.

In cases of all kinds, but more especially in those where the quantity of fluid in the abdomen is small, the introduction of warm sterile white paraffin, in the largest quantities possible, is a great advantage in preventing the reformation of adhesions. Sterile warm oil or vaseline may also be used, or possibly the formaline-gelatine solution used in experimental work by Archibald. I have no personal experience of anything but paraffin.

The reason for the success of simple evacuation of the fluid is not quite clear. On the whole, the explanation given by Gatti seems the most reasonable. He believes that the fluid poured out by the peritoneum after closure of the wound, like the fluid found in the general peritonium when a localised appendicitis is present, is actively bactericidal, and that it exerts a potent deleterious influence upon the tubercle bacillus. It is

certain that in many cases, probably in all, an effusion does occur into the peritoneum in sufficient quantity to be easily recognised on palpation and percussion. Hildebrandt lays stress upon the occurrence of postoperative hyperæmia, which causes a plastic outpouring around the tuberculous nodules, resulting in their fibrous encapsulation. This is a method of "cure" constantly seen elsewhere.

Murphy writes: "If the peritoneum be inspected three or four days after the laparotomy, as I have had opportunity to do on more than one occasion, it will be found intensely congested, its vascularity greatly increased, its gloss almost or quite abolished, and the fluid, not fresh, clear serum, but cloudy or sero-purulent, showing the most active proliferation. It is this tissue proliferation which overwhelms and encapsulates the tubercular foci on the surface of the peritoneum." If the primary focus is the tube, removal of the fluid allows the open tube to fall against the peritoneum, to contract adhesions, and at last to become securely walled off from the general peritoneum. Here, as in so many other parts, the "cure" of tuberculous areas means the encapsulation of the bacilli in the firm grasp of newly formed fibrous tissue.

[I would refer readers interested in this subject to two extremely valuable papers, Dr. J. B. Murphy's "Tuberculosis of the Female Genitalia," and Dr. W. J. Mayo's article in the "Journal of the American Medical Association," April 15, 1905.]

CHAPTER VIII.

SUBPHRENIC ABSCESS.

AN abscess beneath the diaphragm, between it and the liver, may be either intraperitoneal or extraperitoneal; it may lie to the right or to the left of the suspensory ligament of the liver. The intraperitoneal form is decidedly more frequent than the extraperitoneal, and the abscess is more commonly found upon the right side.

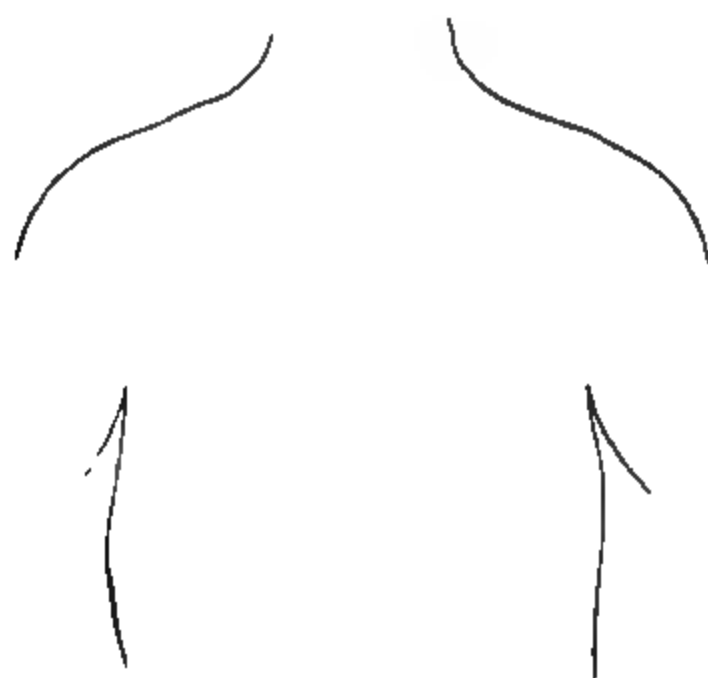


Fig. 28.—Subphrenic abscess (right side).

The upper and posterior surfaces of the liver are partly covered by peritoneum, partly devoid of any serous covering. The suspensory ligament forms an oblique partition, dividing the liver into a larger right, and smaller left, portion.

An abscess which lies to the right of the falciform ligament begins generally in inflammation affecting the gall-bladder, the liver, the kidney, or the appendix. An abscess which lies to the left of this ligament starts, in the majority

of cases, from a perforating ulcer of the stomach or duodenum, or from inflammation in the pancreas, intestines, spleen, or left kidney. The commonest source of infection I formerly believed to be the appendix, but recent statistics do not support this view. Körte reported a series of 60 cases upon

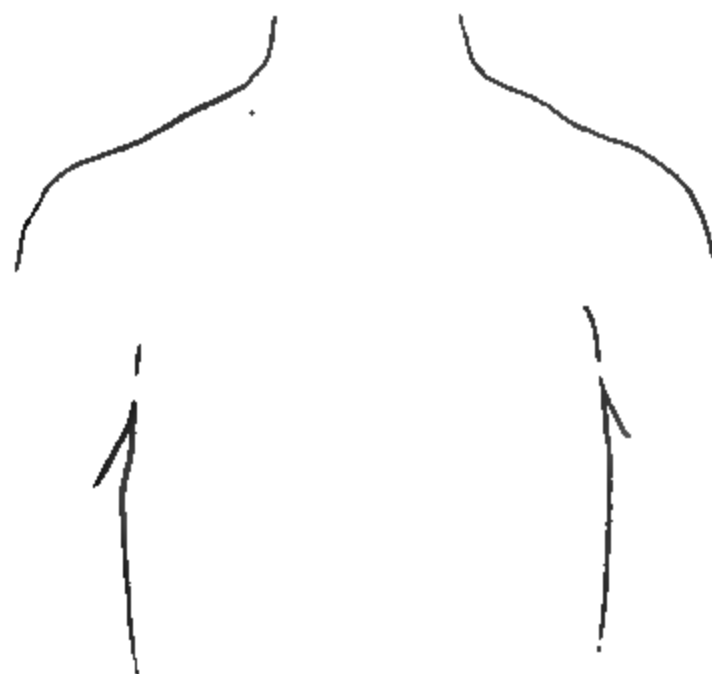


Fig 29 —Subphrenic abscess (left side).

which he had operated, 40 patients recovering. The origin of the abscess was in the appendix in 27 cases; in the stomach in 9; the duodenum in 1; the spleen in 5. He gives the following statement:

SOURCE OF ABSCESS.	NUMBER OF CASES.	RECOVERED.	DIED
Appendix...	27	18	9
Stomach....	9	5	4
Duodenum...	1	0	1
Spleen.....	5	3	2
Kidney.	4	2	2
Liver and gall-bladder.	2	2	0
Pleura....	4	3	1
Costal.....	2	2	0
Pancreas . . .	1	1	0
Hydatid. . . .	3	3	0
Undetermined.....	2	1	1
	60	40	20

Perutz ("Cent. f. d. Grenzgebiet. der Med. und Chir.," 1905, Nos. 4 to 10, inclusive) has collected the records of 208 cases. He gives the following table to shew the starting-point in his own series of cases, and in Maydl's and Körte's:

	IN PERUTZ'S SERIES	IN MAYDL'S SERIES	IN KÖRTE'S SERIES
Stomach	67	35	9
Duodenum	3	8	1
Appendix	55	25	27
Liver and bile passages	17	20	2
Hydatid	5	17	3
Intestine	7	5	0
Pancreas	4	0	1
Spleen	4	0	5
Kidney	7	11	4
Ribs	1	3	2
Intrathoracic	8	9	4
Female generative organs	6	0	0
Traumatic	8	6	0
Metastatic	5	11	0
Various and unknown	11	11	2
Total	208	179	60

E. R. Hunt ("Lancet," Dec. 17, 1904, p. 1718) reports 38 cases of subphrenic abscess occurring at St. Mary's Hospital. In 19 cases the primary lesion was situated in the stomach. The other probable causes were: duodenal ulcer in 3; hepatic abscess in 4; appendicitis in 3; perityphlitis in 4; malignant disease of the stomach in 2; renal calculus in 1; splenic abscess in 1; and injury in 1. Left-sided subphrenic abscesses were met with more frequently than right-sided, and in only 1 of the 19 cases consequent upon gastric ulcer did right-sided abscess occur.

"The pus was situated between the left lobe of the liver, the diaphragm, and the spleen. Sometimes the pus was situated to the left of the spleen, between that organ and the diaphragm. Of this group there were seven examples, all due to perforation through the posterior wall of the stomach. More rarely the abscess might be in front of the stomach and liver, being bounded in front by the diaphragm and ab-

dominal wall and behind by the left lobe of the liver and the stomach; of this group there were three examples. Right-sided subphrenic abscesses were nearly always situated between the liver and the diaphragm, their spreading left and right being prevented by the falciform ligament and the thoracic wall. They tended to extend downwards and backwards in a large number of instances, not infrequently reaching as far as the right kidney."

Fig. 30.—Subphrenic abscess in front of the liver.

Fig. 31.—Subphrenic abscess in the lesser sac.

The inflammation from the appendix may spread upwards, within the peritoneal cavity, along the outer side of the colon, in the manner already described, or it may pass upwards in the loose cellular tissue behind the colon.

When an ulcer of the stomach destroys, by slow degrees, the entire thickness of the wall, a "*chronic perforation*" occurs and a perigastric abscess results. In many cases this abscess lies immediately beneath the diaphragm.

Disease of the gall-bladder, bile-ducts, and intrahepatic ducts may all lead to diffuse suppuration between the liver and the diaphragm. Abscesses, at first within the substance of the liver, may, in a later stage, and in their gradual enlargement, burst through the bounds of the liver and become subphrenic.

In the majority of cases a subphrenic abscess contains gas, which is derived, as a rule, from the action of gas-forming bacteria, but may also come from a hollow viscus. For this reason gas is more often found to be present in an abscess on the left side than in one on the right.

The diagnosis of subphrenic abscess is often difficult, especially if there be no free gas within the cavity. When there is fluid, serous or purulent, at the base of the right lung, this difficulty is considerably enhanced. The physical signs that may be elicited are the following:

On the right side posteriorly there will be dulness at the base of the chest. If there be no free gas within the abscess, the liver dulness will merge above into the dulness produced by the overlying pus. The

upper edge of this dull area will be convex. The physical signs are, therefore, the same, in such a case, as in a case of abscess of the liver. When, however, gas is present within the abscess, the signs are most characteristic. Percussion reveals three zones of different resonance, one above the other. The upper is the normal resonance of the lung; in the middle there is the tympany due to the gas within the abscess; in the lower, the dulness due to the fluid within

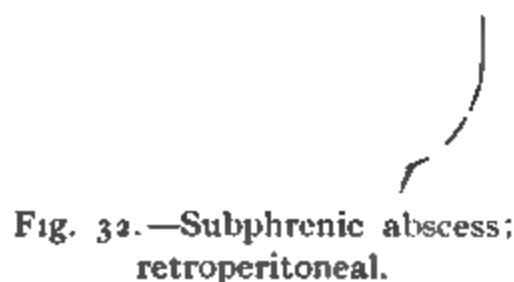


Fig. 32.—Subphrenic abscess; retroperitoneal.

the abscess; this latter dulness merges into the dulness of the liver.

Abscesses on the left side, coming as they do from the stomach or duodenum, contain gas; the physical signs, therefore, are generally those which have just been described.

When pleuritic effusion is present above the subphrenic abscess, four zones of varying resonance may be encountered. The topmost is the normal resonance; the next is a dulness due to the pleuritic fluid; the next, a tympany due to the gas of the abscess; and, lowest of all, a dull area due to the pus in the abscess cavity.

An abscess on the right side may push the liver downwards. On both sides a bulging of the chest-wall or of the anterior abdominal wall may be seen.

The diagnosis in all cases must be verified by the examination of the chest with an exploring needle of fair size and of good length. As a rule, the most sensitive part of the dull area is selected for the introduction of the needle; repeated introduction of the needle may be necessary, for the pus is often thick and will not run easily through even a stout needle. In some cases there is a thick, tenacious layer of lymph on the upper surface of the liver, and this blocks the needle instantly.

The frequency of the association of pleural complications in cases of subphrenic abscess can only be gauged with certainty in cases which are operated upon by the transpleural method, or in those fatal ones where a postmortem examination is made. In Körte's series of 60 cases (reported by Grüneisen) pleural complications were found in 40. In Perutz's series of 208 cases it is noted that pleural affections were observed in 55, but in many cases the abscess was opened by median or lateral abdominal incision. In some no operation was performed; in some the clinical record is brief. Körte makes the interesting observation that in the cases where he performed a transpleural operation the pleura "was seldom free from disease."

OPERATION.

Subphrenic abscesses may be opened in one of four ways:

1. By incision through the anterior abdominal wall.
2. By incision along the lower costal margin.
3. By incision through the chest-wall and diaphragm.
4. By a combination of the thoracic and abdominal incisions.

1. Incision through the anterior abdominal wall is suited to those cases of large abscess which bulge forward in the epigastrium. These are, almost without exception, due to perforation of the stomach.

The abdomen having been opened, the abscess is reached, and its contents, often of amazing offensiveness, are evacuated. After the gas and much fluid have escaped, a pool of pus will be found to lie far back in the cavity. This must be mopped up with swabs and the posterior limit of the cavity defined. It will then generally be found necessary to make a counter-opening into the abscess from the loin in order to ensure efficient drainage. Both anterior and posterior wounds are drained. I have found the split rubber drain, of a diameter of an inch and a half, the best of all forms to use. The cavity may, if thought desirable, be washed out with hot saline solution or with a solution of peroxide of hydrogen.

2. The incision along the costal margin is carried through all the muscles of the abdominal wall. The further deepening of the wound is accomplished with great care, by blunt dissection with the finger, until the limits of the abscess are reached. A small opening is then made into the cavity and gradually enlarged in the direction in which it is clear that no harm can be done. This method is advocated by von Mikulicz for extraperitoneal abscesses on the right side.

3. The transpleural operation is that most often employed. An incision, five or six inches in length, is made over the

ninth or tenth ribs, on the right side, and over the seventh or eighth on the left side, the middle of the incision being at the point from which pus has been withdrawn by the exploring needle. The ribs are exposed, and about $3\frac{1}{2}$ or 4 inches of each are excised. The condition of the pleural cavity is then determined. If it is empty or contains only clear fluid in small quantity, it must be protected from infection, either by packing the wound tightly with gauze and postponing the completion of the operation for twenty-four hours, or by the introduction of stitches which include the diaphragm, both layers of the pleura, and the chest-wall. After the stitches have been passed, a little gauze packing is pressed around the edges of the wound so as to form a sort of barrier. The diaphragm is then incised, the cut edges seized with forceps and drawn forwards (this is generally easily accomplished as the diaphragm is pushed well upwards by the abscess beneath it), and the cavity emptied, washed out gently, and drained with a large cigarette drainage-tube.

4. A combination of the thoracic and abdominal incisions is in some instances an advantage in that it secures a more certain drainage. The thoracic incision is carried on to the abdomen, and the cavity above the liver freely opened. An abundant supply of gauze is introduced into the cavity and frequently removed in order to ensure free drainage and a speedy healing.

Perutz gives the following tabular statement of the results of cases treated by operation in the three series already mentioned:

TABLE OF CASES TREATED BY OPERATION.

	IN PERUTZ'S SERIES			IN MAYDL'S SERIES			IN KÖRTE'S SERIES		
	Total	Recov- ered	Died	Total	Recov- ered	Died	Total	Recov- ered	Died
Stomach.....	47	33	14	10	3	7	9	5	4
Duodenum.....	1	0	1	2	0	2	1	0	1
Appendix.....	40	30	10	14	9	5	27	18	9
Liver and bile passages.....	12	11	1	5	4	1	2	2	0
Hydatid.....	4	3	1	14	8	6	3	3	0
Intestine.....	6	2	4	2	0	2	0	..	..
Pancreas.....	3	1	2	0	..	..	1	1	0
Spleen.....	3	3	0	0	..	..	5	3	2
Kidney.....	6	5	1	7	1	6	4	2	2
Ribs.....	1	1	0	3	3	0	2	2	0
Intrathoracic.....	6	5	1	2	1	1	4	3	1
Female organs.....	5	4	1	0	..	..	0	..	..
Traumatic.....	7	7	0	6	6	0	0	..	..
Metastatic.....	5	4	1	3	1	2	0	..	..
Various and unknown.....	9	7	2	6	3	3	2	1	1
Total.....	155	116	39	74	39	35	60	40	20

The two most striking facts brought out by this table are the diminution in the mortality during the last few years, and the small mortality in those cases where the abscess depended upon diseases of the liver- or bile-passages. The cases in Maydl's series were treated up to the year 1894, in Perutz's series from 1894 to 1904. The mortality in the first series was 48 per cent.; in the second 26 per cent.

Perutz also analyses the 53 cases in which no operation was performed. Of these 44 died and 9 recovered, a mortality of about 85 per cent. In Maydl's unoperated cases, 104 in number, there were 98 deaths.

H. L. Barnard ("Brit. Med. Jour.," 1908, i, pp. 371, 429) has analysed 76 consecutive cases of subphrenic abscess and has written an exhaustive paper on their incidence, ætiology, pathology, anatomical relationships, and treatment. He classifies the subphrenic fossæ as follows:

Intraperitoneal	Right anterior.
	Right posterior.
	Left anterior.
	Left posterior.
Intraperitoneal	Right.
	Left.

The division of these spaces being made by the coronary, falciform, and the right and left hepatic ligaments. The falciform ligament divides the subphrenic space into right and left compartments; each of these being again subdivided into a larger anterior and a smaller posterior part by the corresponding lateral ligament. The right extraperitoneal subphrenic space lies between the layers of the coronary ligament and is really only a potential space. The left extraperitoneal subphrenic space is in the neighbourhood of the upper pole of the left kidney. The following is an analysis of Barnard's cases.

ANALYSIS OF CASES.

ANATOMICAL VARIETIES.

	NO. OF CASES.	SIMPLE.	COMPOUND.
A. INTRAPERITONEAL.			
I. Right:			
(a) Anterior.....	27	11	16
(b) Posterior.....	10	0	10
II. Left:			
(a) Anterior.....	30	26	4
(b) Posterior.....	3	1	2
B. EXTRAPERITONEAL.			
I. Right.....	19	13	6
II. Left.....	4	4	0
Not classified.....	2	..	..

Simple = One cavity only involved.

Compound = Two or more cavities involved.

ANATOMICAL VARIETIES ACCORDING TO CAUSES.

ANATOMICAL VARIETY.	GASTRIC ULCER.	APPENDICITIS.	HEPATIC ABSCESSSES.	DUODENAL ULCER.
Intraperitoneal right anterior ..	4	10	7	1
Intraperitoneal right posterior..	1	6	1	2
Intraperitoneal left anterior....	16	1	1	1
Intraperitoneal left posterior ..	2	0	0	0
Extraperitoneal right.....	0	1	15	2
Extraperitoneal left.....	1	0	0	0

ETIOLOGY.

	CASES.
Gastric ulcer.....	21
Gastric cancer.....	2
Appendicitis.....	12
Liver: Suppurating hydatid.....	8
Liver: Tropical abscess.....	6

	CASES.
Liver: Abscess.....	1
Pylephlebitis.....	1
Suppurative cholangitis.....	1
Duodenal ulcer (anterior).....	3
Duodenal ulcer (posterior).....	2
Splenic abscess.....	3
Pyæmia.....	3
Parturition.....	3
Thoracic pneumonia.....	1
Thoracic bronchiectasis.....	1
Thoracic empyema.....	1
Periostitis of vertebræ.....	2
Operations, resections.....	2
Pancreas cancer.....	1
Kidney cystic.....	1
Intestine ruptured.....	1
Typhoid.....	1
Gall stones.....	1
Pyosalpinx.....	1
No cause found.....	2

AGE OF 75 CASES OF SUBPHRENIC ABSCESS ARRANGED IN DECADES.

Age.....	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Cases.....	6	5	29	15	13	6	1

SEX OF 76 CASES OF SUBPHRENIC ABSCESS.

	CASES.	PER CENT.
Male.....	43	56.6
Female.....	33	43.4
Total.....	76	100

THE SPONTANEOUS RUPTURE OF 23 CASES OF 76 SUBPHRENIC ABSCESSES.

Into—	CASES.
A bronchus.....	4
The pleura, right.....	2
The pleura, left.....	3
The general peritoneum.....	1
The stomach.....	8
The intestine.....	1
The colon.....	2
The skin (a) umbilicus.....	1
(b) right hypochondrium.....	1
	23

MICRO-ORGANISMS FOUND IN PUS OF SUBPHRENIC ABSCESES.

	CASES.
Number examined.....	12
Sterile.....	3
<i>B. coli communis</i>	3
<i>Staphylococcus aureus</i>	2
<i>Streptococcus</i>	1
<i>Pneumococcus</i>	1
<i>B. pyocyaneus</i>	1
<i>B. typhosus</i>	1

ONSET IN 76 CASES OF SUBPHRENIC ABSCESES.

Acute.....	40 cases = 62.6 per cent.
Subacute }	36 cases = 47.4 per cent.
Chronic }	
Gastric ulcer (21 cases):	
Acute.....	15
Subacute }	6
Chronic }	
Gastric cancer (2 cases):	
Acute.....	0
Subacute }	2
Chronic }	
Appendicitis (12 cases):	
Acute.....	12
Subacute }	0
Chronic }	
Hydatid of liver (8 cases):	
Acute.....	2
Subacute }	6
Chronic }	
Hepatic abscesses (7 cases):	
Acute.....	1
Subacute }	6
Chronic }	
Duodenal ulcer (5 cases)	
Anterior (= Acute).....	3
Posterior (= Subacute)	2
Splenic abscess (3 cases):	
Subacute.....	3

THE SIGNIFICANCE OF RIGORS IN SUBPHRENIC ABSCESES

	CASES.
Number recorded.....	10
Died.....	6
Pyæmias (2 chronic ones lived).....	5
Communicated with stomach.....	2
Suppurative cholangitis.....	1
Acute periostitis.....	1

THE USE OF THE ASPIRATING NEEDLE IN EIGHTEEN CASES OF SUBPHRENIC ABSCESES. SOME SEVERAL TIMES.

	CASES
Failed to diagnose.....	11
Pus.....	7
Foul pus.....	2
Anchovy pus.....	1
Pus and serum.....	1
Clear serum.....	4
Blood-stained serum.....	2
Gas.....	2

MORTALITY OF 76 CASES OF SUBPHRENIC ABSCESS.

	DEATHS.		PER CENT.
76 cases.....	36	=	47.4
12 cases no operation.....	12	=	100.0
64 cases operated on.....	24	=	37.0
21 cases operated on by author.....	4	=	19.0

ANALYSIS OF 36 DEATHS.

(A) *Unavoidable*.—12 deaths = 16 per cent. (about).

Multiple abscesses of liver.....	5 cases
Cancers.....	2 "
Hour-glass stomach.....	2 "
Lung complications.....	2 "
General peritonitis.....	1 case

(B) *Avoidable (probably)*.—24 deaths.

Not operated on.....	12 cases
Anterior operation; other pouches left.....	8 "
Transpleural operation in diffuse stage.....	2 "
General peritoneum opened by anterior incision.....	1 case
Inefficient needling.....	1 "

The Ideal Mortality of Subphrenic Abscess = about 16 per cent.

CHAPTER IX.

THE SURGICAL TREATMENT OF VISCERAL PROLAPSE.

THE SURGICAL TREATMENT OF GASTROPTOSIS.

GASTROPTOSIS is a disease, the frequency and significance of which are variously estimated by different writers. Glénard found a condition of enteroptosis in 400 out of 1300 patients, and has given us the most complete description of the disease which has been published.

The circumstances which are present are these: There is a weakening of all the natural supports of the viscera; the peritoneal ligaments are long, lax, and unequal to their burden, and the abdominal wall in its lower part is pushed forwards, bulging in characteristic fashion; a passive dilatation of any parts, or of all parts, of the alimentary canal may be present.

The patient complains chiefly of a sense of a heavy weight, of dragging, and of weariness in the abdomen. There is often nausea, and sometimes vomiting; there are fulness, flatulence, eructations. The bowels act irregularly, and constipation is always a prominent feature. The patient is almost always a neurasthenic of a most pronounced type.

An examination will disclose the circumstances mentioned above—a laxity of the supports and consequently an undue mobility of all the organs in the abdomen.

In the great majority of cases relief is afforded by the wearing of an abdominal belt. In some cases, however, the wearing of a belt has proved ineffective and resort has been had to surgery. The operation practised is known as “gastropexy.”

Duret's Operation.—It is to Duret, of Lille (“*Revue de Chir.*,” 1896, p. 430), that we owe the first suggestion for the performance

of the operation of "gastropexy." His patient was a married woman who had suffered very severely for three years from gastroptosis. The method adopted for the purpose of fixing the stomach up to the abdominal wall in approximately its proper position was as follows: A long incision was made in the abdominal wall from the xiphoid cartilage to the umbilicus down to the peritoneum. The peritoneum in the upper part of the wound was not incised, but was bared on its anterior surface by

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Fig. 33.—Gastropexy; Duret's operation.

stripping away the recti from it. The abdomen was opened through the lower part of the peritoneum. The stomach was then sought. Through the stomach and the undivided peritoneum in the upper half of the wound a suture was passed. The suture was of silk and was continuous; it was passed at first through the left edge of the parietal incision, through fasci, rectus muscle, and peritoneum, and then horizontally through the serous and muscular coats of the stomach, close to the lesser curvature. The needle was now passed from

within outwards through the uncut peritoneum, and then back into the abdomen, again to pick up the stomach as before. A series of loops of this suture were then taken. As soon as the stitch was tightened the stomach was slung upwards and there fixed. The patient did well, was relieved of

Fig. 34 —Gastropexy; Rovsing's operation. The area between the stitches is scarified with the intention of promoting firmer adhesions.

her very distressing symptoms, and in two years had gained 25 pounds in weight.

A similar operation to this was performed by Davis, but in place of the stomach the lesser omentum above the stomach was picked up by the stitch.

Rovsing's Operation. —Rovsing, of Copenhagen, has per-

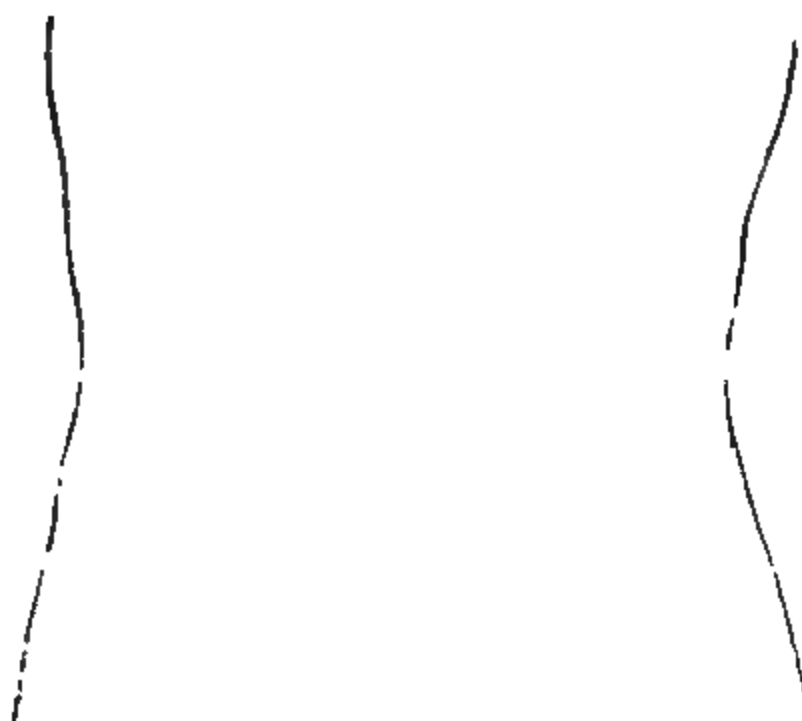


Fig. 35.—Gastropexy; Coffey's operation. The suture of the omentum to the anterior abdominal wall.

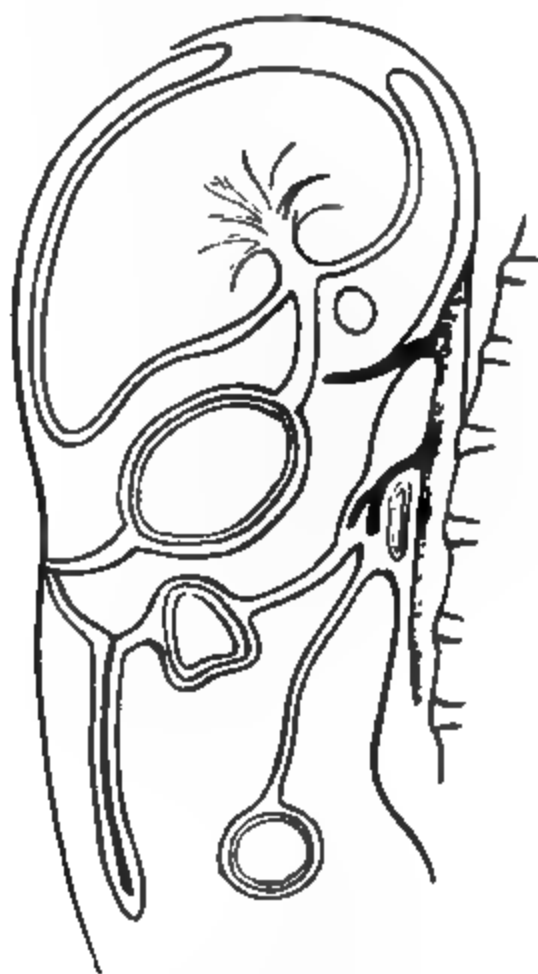


Fig. 36.—Gastropexy; Coffey's operation. The suture of the omentum to the anterior abdominal wall.

formed a large number of operations by a method of his own. The method consists in passing three stout sutures of silk transversely through the stomach, picking up only the outer coats. At each end the silk is tied over a glass rod, after being taken through all the layers of the abdominal wall. The stitches are removed at the end of four weeks, when the stomach is "solidly fixed" to the anterior abdominal wall.

Rovsing describes two forms of gastroptosis: (1) That which he describes as "virginal," which is the rarer but which is the more important, since the very great majority of the cases needing operation belong to this class. The abdominal wall is firm and strong. (2) That which occurs in multiparous women; it is often accompanied by considerable prolapse of other viscera, causes little pain, and is often relieved by well-fitting bandages.

Bandages are of no value in the "virginal" form because the abdominal wall, being sound, does not allow adequate, properly directed pressure to be exerted by any external appliance.

Rovsing has operated upon 49 cases; 44 belonged to the "virginal" class, 5 to the "multiparous." In only 6 of the cases was there gastric stasis. All the patients recovered from the operation and all were relieved, with the exception of one case where there was also a narrowing (unnoticed at the time) of the duodenum due to old adhesions. In one case, gastropexy was combined with hepatopexy; in another, removal of the extremity of an enlarged left lobe of the liver was also performed.

Clarence Webster, in cases associated with divagation of the recti, remedied this condition by resection of the fascia and approximation of the muscles.

Depage in 1893 advocated a shortening and tightening of the abdominal wall in all its diameters by an extensive plastic operation. The operation, however, is a formidable one. Further objections are that the ligaments are not shortened and a second stretching of the abdominal wall may ensue.

Coffey's Operation.—Coffey supports the stomach by suturing



Fig. 37.—Beyea's operation for gastropexy—the first layer of sutures.



Fig. 38.—Beyea's operation for gastropexy—the first layer of sutures completed; the second and third being introduced.

the omentum along the greater curvature to the abdominal wall, above the umbilicus.

Beyea's Operation.—The most satisfactory method is probably that suggested by Beyea ("Philadelphia Med. Jour.," February, 1903, p. 257). The operation is described in the following manner:

"An incision, about three inches in length, was made through the linea alba, midway between the xiphoid cartilage and umbilicus. The tissues were separated in the usual manner and the peritoneal cavity opened, exposing a small portion of the lesser curvature and cardiac end of the stomach, the gastrohepatic ligament or omentum, gastrophrenic ligament, and the lower portion of the left lobe of the liver. The table was then elevated to the Trendelenburg position, and the stomach displaced still further downwards and out of the wound by means of gauze sponges. This procedure caused the gastrohepatic and gastrophrenic ligaments to be slightly stretched and separated from the underlying structures, which permitted an accurate determination of the length of these ligaments and very much facilitated operative manipulations. The gastrophrenic ligament was seen well developed, and evidently formed a strong support to the cardiac end of the stomach. The joining portion of the gastrohepatic ligament was composed of thin, delicate peritoneum, increasing in thickness and strength towards the right or pyloric end of the stomach. Retractors were introduced and the liver held aside by placing a gauze sponge beneath a retractor. Three rows of interrupted silk sutures were then introduced so as to plicate and thus shorten the gastrohepatic and gastrophrenic ligaments in the following manner: The first row, beginning in the gastrophrenic ligament and extending across the gastrohepatic ligament to almost opposite the pyloric orifice and hepaticoduodenal ligament, was introduced so as to form a plication in the centre of these ligaments, and included from above downward or vertically about 4 cm. of tissue (row No. 1). They were practically mattress sutures, including sufficient of the delicate tissue (1 cm.) to ensure against their tearing out. Five sutures, about one inch apart, were introduced from right to left, and caught in hæmostatic forceps. The next row (row No. 2) of sutures was introduced in the same manner, but 2.5 cm. above and below the first two. Then a third row

(row No. 3) was introduced just above the gastric vessels and a short distance below the diaphragm and liver. The suturing was strictly confined to the normal ligamentary supports, and the distance between the rows from left to right was increased with the length of the ligaments, being greater towards the right. The gauze sponges were then removed, and the first, the second, and finally the third row of sutures were secured, the stomach, particularly the pyloric end, being elevated to a little above the normal position."

The sutures were of silk. Four successful cases are recorded. A similar operation has been performed by Bier. In a recent letter Dr. Beyea kindly informs me that he has operated in eight cases, with marked benefit in all. The first case remains well after about eight years. I have only once performed the operation, and the result has been very good.

The advantage of the operation just described is that it does not solder the stomach to the anterior abdominal wall, and, therefore, does not interfere with the proper mobility of the organ.

There are, doubtless, cases in which an operation of this kind is necessary. Such cases, however, are few. The treatment by external mechanical supports should always be given a long trial before surgical measures are advocated, and consideration must always be given to the fact that the patients are often of a profound neurotic type.

HEPATOPTOSIS.

By hepatoptosis is understood that condition of prolapse or dropping of the liver due to the inadequacy of the suspensory apparatus. A mere depression of the liver by fluid accumulations above it, or by lateral deviations of the spine, is, therefore, not included in the definition.

The condition was first accurately described by Cantani in 1866. Two forms are generally recognised:

- (a) Partial hepatoptosis, in which there is a downward prolongation of a portion of the liver. This results in the condition known as "Riedel's lobe," "floating lobe," or "linguiform lobe."
- (b) Complete hepatoptosis, in which there is a downfall of the whole organ.

The suspensory apparatus of the liver seems at first sight singularly unfitted for the burden that is laid upon it. The following are the chief means by which the gland is held in position:

1. The vena cava. It has been shewn by Faure that the most substantial support to the liver is afforded by the vena cava. He likens the relation of the vena cava and the liver to that which obtains in the case of the heart and the great vessels.

2. The ligaments proper to the liver.

3. The intra-abdominal pressure—due, in part, to the tension of the anterior abdominal wall, and, in part, to the presence beneath the liver of the mass of the stomach and intestines. The influence of this factor, which is considered of the first importance by Sappey, Landau, and others, is, by Faure, not altogether denied, but asserted to be quite insignificant.

The dropping of the liver is not a perfectly simple vertical movement. The posterior surface of the liver, owing to the strong attachment of the vena cava, moves the least; the anterior border moves the most. There is a sort of nodding movement, or a movement of rotation around a transverse axis through the posterior part of the organ. In addition it must be noted that the right, larger, lobe moves further downwards than the left lobe. The anterior sharp edge of the liver becomes, therefore, lower and lower, and the upper convex surface becomes, at the same time, more and more inclined to look forwards.

Associated in many cases with this downfall of the liver

is a marked deformity, which consists most often in a flattening of the gland, especially of the right lobe. The anterior and inferior surfaces are increased at the expense, respectively, of the superior and the posterior surfaces. In not a few cases a deep transverse furrow is seen to lie along the anterior surface of the right lobe; the peritoneum which lines this groove is thick and milky in its opacity. This shape of the liver is most often found in association with a Riedel's lobe.

"Riedel's lobe" is a downward projection from the right lobe of the liver, immediately to the right of the gall-bladder. In very rare instances the elongation may proceed from the quadrate lobe, immediately to the left of the gall-bladder. This linguiform process is associated almost always with gall-stones, and is caused, so it is said by Riedel, by the gradual distension of the gall-bladder dragging downwards that portion of the liver in its immediate vicinity. Both Riedel and Terrier have shewn—and the observation has been abundantly confirmed—that when the gall-bladder, so affected, is drained of its contents by the performance of cholecystotomy, the projection is gradually withdrawn, and the conformation of the liver returns slowly to the normal.

The symptoms which are caused by this downward slipping of the liver need not be detailed here. Suffice it to say that the patients who suffer therefrom are, in 90 per cent. of the cases, women, in whom a prolapse of other organs—the kidney, the stomach and intestines, and the uterus—can also be recognised. Hepatoptosis is only a part of a general visceral prolapse, a condition known as enteroptosis, or Glénard's disease. It is well known that the sufferers are, for the most part, neurotic in type.

TREATMENT.

As a rule, the most successful treatment consists in the application of a well-fitting belt. The type of inflatable rub-

ber pad recommended by Byron Robinson is probably the most satisfactory of all. In the more obstinate cases surgical aid will be called in for the purpose of dealing with a painful "floating" lobe or of fixing a wandering liver which cannot adequately be kept in position by any mechanical support.

Riedel's lobe has been treated by excision, by fixation to the abdominal wall, and by cholecystotomy.

Removal has been performed by Langenbuch, Bastianelli, and Lockwood; it can be needed only when the lobe is the seat of a pain that cannot otherwise be relieved. Suture of the lobe to the parietes was first performed by Billroth in 1884; later, by Tscherning and Langenbuch. The performance of cholecystotomy for this condition is, of course, within the experience of many surgeons.

Total Hepatopexy.—The first operation *for the purpose of fixing the whole liver* was performed by Gerard-Marchant in 1891, though it had been suggested by Kisbert in 1884. He sutured the thin anterior edge of the liver to the costal margin by silk sutures. This method has been followed in the majority of subsequent operations. A portion of the liver substance has been picked up by a series of sutures of stout silk, and each suture fixed to the anterior abdominal wall or to the costal margin. For the purpose of carrying the suture through the liver the needle suggested by Kousnetzoff should be employed. In addition to the sutures so passed, undoubted help would be gained by the denudation, by vigorous gauze friction, of all parts of the liver, so that the formation of adhesions might be more certainly accomplished.

Legueu suspends the liver by a stout double thread which passes completely through it from side to side.

Péan, by a procedure which he called "cloisonnement peritoneal horizontal," was able securely to fix a mobile liver. He made a transverse incision through the anterior abdominal wall, replaced the prolapsed liver, and then erected a barrier

below it by suturing the peritoneum of the anterior abdominal wall to that of the posterolateral wall.

Francke adopted the following plan: A series of sutures were passed along all the anterior margin of the liver except the part near to the gall-bladder, uniting this edge to the costal margin. Between the upper surface of the liver and the diaphragm gauze was packed in and left for eight days. On its removal firm adhesions formed between the two apposed and granulating surfaces.

The best plan to follow would seem to me to be this: To make an incision obliquely, about one inch below the margin of the costal cartilages; to replace the liver; to fix the anterior edge securely with several sutures to the costal margin; to pack in between the liver and the diaphragm and possibly also beneath the right lobe of the liver many strips of gauze, which should be left in place a week; to keep the patient absolutely at rest in bed (with the foot of the bed elevated a few inches) for at least one month.

It must be borne in mind that surgery is called for only in the most extreme cases, and regard must always be had to the fact that a neurotic element is a marked feature in all these patients.

J. G. Clark ("Surg., Gyn. and Obst.," 1908, p. 339), in a paper on the surgical phases of enteroptosis, groups the cases as follows:

1. Cases of congenital habitus.
2. Cases of acquired enteroptosis.
3. Cases of enteroptosis following post-operative adhesions, hernia, or the removal of large tumours.

The first type of case is usually not improved by operation. Cases of the second type include women who have borne children in rapid succession, the habitually constipated, and the too tightly laced.

Clark mentions 35 cases with a percentage of about half this number of symptomatic cures. The types of operation performed were Webster's plastic operation on the abdominal wall,

suspension of the sigmoid, suspension of the transverse colon by omentoventral suture, and Beyer's operation. Amongst Clark's conclusions are:

1. No case should be operated upon until medical and mechanical measures have been exhausted.
2. Cases due to congenital habitus are unrelieved by surgery.
3. In order for an accurate estimation of the degree of ptosis x -ray should be employed.
4. Ptosis following childbirth is improved by resection of the relaxed ventral tissue after the method of Webster.
5. In marked cases of ptosis of the transverse colon with stasis and symptoms of partial obstruction, partial colectomy is necessary.
6. Redundant sigmoid may necessitate either suspension or sigmoidectomy.
7. In all cases an abdominal support should be worn.

SECTION II.

OPERATIONS UPON THE STOMACH.

CHAPTER X.

OPERATIONS FOR PERFORATING GASTRIC OR DUODENAL ULCERS.

THE perforation of a gastric or duodenal ulcer is one of the most serious and most overwhelming catastrophes that can befall a human being. The onset of the symptoms is sudden, the course rapid, and unless surgical measures are adopted early, the disease hastens to a fatal ending in almost every instance.

Perforation of the stomach is usually described as being of two varieties—*acute* and *chronic*; but there is, as I first pointed out, an intermediate class of cases, not embraced by either of these terms, which is best described as *subacute*.

In **acute perforation** the ulcer gives way suddenly and completely. A larger or smaller hole results, and through this the stomach-contents are free to escape at once into the general cavity of the peritoneum.

In **subacute perforation** the ulcer probably gives way almost as quickly as in the acute form, but, owing to the small size of the ulcer, or to the emptiness of the stomach, or to the instant plugging of the opening by an omental flap or tag, or to the speedy formation of lymph which makes, as it were, a cork or lid for the ulcer, the escape of fluid from the stomach is small in quantity and the damage inflicted thereby is less considerable. The symptoms at their onset may be as grave as those in acute perforation, but on opening the abdomen

the ulcer may be found to be sealed over, and no further escape of fluid is occurring.

In the subacute form of perforation I have found that there is always a complaint of greater discomfort for several days preceding the rupture. Vague general or localised pains have been felt in the abdomen, or a sharp spasm or "stitch" when the patient turned quickly or attempted to laugh. One

girl, a housemaid, felt the pain down her left side, especially when reaching up to her work; another said it hurt her to bend, as her side felt stiff. These premonitory symptoms are important, and if recognised, they should enable us to take measures to prevent the occurrence of perforation. They doubtless have their origin in a localised peritonitis, and the stiffness is due to the unconscious protection of an inflamed area by a muscular splint.

Fig. 39.—A perforating round ulcer causing death in a lady of twenty-two. This is the common condition. There is a *chronic* ulcer with an *acute* perforation (Museum of Royal College of Surgeons of England, No. 2396).

develop at the base. The escape of stomach-contents is, therefore, merely local; barriers of lymph confine the fluid to a restricted area, and a perigastric abscess forms. A chronic perforation occurs more frequently on the posterior surface of the stomach, and the perigastric abscess occasioned thereby is recognised as "subphrenic." The acute and subacute forms of perforating ulcer are more common on the anterior surface.

In **chronic perforation** the ulcer has slowly eaten its way through the stomach-coats, and a protective peritonitis has had time to de-

There can be no doubt that recovery by **medical treatment** alone is possible both in the acute and in the subacute forms of perforation. I have had two cases under my care in which a diagnosis of perforation had been made by competent medical men. In both, an operation was impossible, as no skilled help was available until the urgency of the symptoms seemed to have passed off. When I operated, many months later, the evidence of peritonitis completely surrounding the stomach was undeniable. Though patients may recover, their recovery cannot be urged as a reason for the delay or withholding of surgical help in all cases, for the possibility of spontaneous recovery, though not denied, is yet so remote as to make it imperative to adopt operative treatment at the earliest possible moment. The risk of operation is definite; the hazard of delay is immeasurable.

It is by degrees becoming more generally recognised that chronic ulcers of the stomach and of the duodenum are conditions that can be diagnosed with an approximation to accuracy which, though it leaves much to be desired in the case of the former, is almost exact in the case of the latter. And increasing confidence is being displayed in the view, which some amongst us have long expounded, that chronic ulcers are in all cases in need of surgical treatment. We may accordingly have reasonable expectations that with earlier and more confident diagnosis and with a speedier resort to operative measures, the final and often long-deferred catastrophe of perforation in a chronic ulcer may be wholly avoided. Whenever a patient who has complained at intervals of indigestion begins to suffer in the present attack more acutely than in an earlier one, the signal of impending perforation is being raised and the clear warning should by no means go unheeded.

At the moment when perforation occurs there is the most agonising and unendurable pain. Patients will afterwards say that there is no pain so horrible in its torture as this. The least movement seems to add something to its severity, so that a patient will perhaps remain for hours almost without stirring. A

medical man upon whom I operated told me that the perforation had occurred while he was crouched on his hands and knees in bed in a position which seemed to relieve his pain. When the rupture of the ulcer took place he could not move to reach the bell, and had to wait motionless until help came to him in the early morning. The tense rigidity of the whole body is in striking contrast to the ceaseless unrest of a patient who is suffering the agony of hepatic colic. In him a constant change of position and of pressure seems in some measure to cause abatement of the pain, or, at least, to be imposed upon the patient in the search for relief that never comes. The abdominal muscles are found to be in a condition of inflexible rigidity, but even here some difference in the various parts of the abdomen can be felt. Over the ulcer the stiffness is of the most obdurate character; one might almost think that a disc of metal replaced the supple muscle. This local increase of a general resistance is most definite and distinct, as a rule, and it affords a decided help not only in the diagnosis of the lesion but in its location. The patient's expression is of one who is terror-struck. The approach of a hand to the abdomen for the purposes of examination is quickly resented, and the most piteous appeal for gentleness is made. The breathing is short, jerky, and shallow, and the patient may indeed cry out that he "cannot breathe." This is due in part no doubt to a spasm of the diaphragm, and in part also, I believe, to that great over-distension of the stomach which is so commonly seen when the abdomen is opened. Though the patient looks generally ill—with pallid face, staring eyes, and sweating brow—the pulse will be found at the first to be hardly altered in frequency or in volume. This is one of the surprises which must not fail to be recognised and remembered. I have often been told by medical men that at the first view of a case they could hardly bring themselves to believe in the occurrence of a perforation, since the pulse was so tranquil and full; and in a case I saw some years ago with Dr. Carlton Oldfield, we deliberately postponed for a few hours any question of operative treatment because the pulse, in rate and

volume, was normal. Unhappily, this fact of the unaltered pulse-rate is even now not generally recognised; accordingly delay, which is always serious, may occur. The pulse increases in frequency and depreciates in value very soon, but this is due not to the perforation but to the peritoneal contamination which is the inevitable sequel. No one has any difficulty in recognising the presence of peritonitis, but our aim must always be to discover at the moment of its occurrence the lesion to which the peritoneal infection is secondary. The symptoms and the signs of the perforation of a hollow viscus are not those of the peritonitis, which make haste to develop.

I have seen a difficulty in diagnosis arise, and I know of three cases in which negative exploration has been performed, when the patient was a woman at the commencement of a menstrual period. From some unexplained and indeterminate cause a sharp attack of abdominal pain, followed by vomiting, distension, prostration, and collapse had occurred in all and had caused a confusion in the diagnosis. In the case under my own observation, a history of previous similar, though less severe, attacks at the menstrual epoch, and the absence of any marked abdominal stiffness or tenderness, though the belly was obviously distended, enabled me to negative the question of perforating ulcer of the stomach.

The Operation.—The operation should be conducted as speedily as possible, and all measures adopted to save the patient from shock. The patient should be operated upon in the recumbent position so that fluid drains away from the diaphragm which absorbs very rapidly, to the pelvis from which absorption is very slow.

The abdomen is opened in the middle line, above the umbilicus, by an incision of ample size. The work which it is necessary to do cannot be efficiently done through a small opening—the surgeon must not be cramped. It is quicker to stitch up a large wound than to operate through an un-

duly small one. The wound is made to left or right, in accordance with the discovery of that area of greater local rigidity to which reference has already been made. It is almost always possible to make the incision in the close neighbourhood of the ulcer. In some doubtful cases a small suprapubic incision may first be made; the character of the exudate will then declare the nature of the perforation, whether of the stomach, duodenum, gall-bladder, intestine or appendix. The little incision is used subsequently for drainage. As soon as the abdomen is opened, gas or a little thin, clear or turbid fluid will escape. Both gas and fluid are inodorous, and when the fluid is examined, it is found in many cases to be sterile. The amount of gas and of fluid will depend upon the length of time that has elapsed since the perforation: if less than six hours have passed, there will be little or no gas, and the fluid will be clear or almost so. This fluid is poured out by the peritoneum as a protective measure, and is not only sterile, but is actively antibacterial. As more and more of the stomach-contents escape, the fluid becomes more turbid. Portions of semidigested food may be found in the peritoneum, and I once saw an orange-pip there.

The ulcer is rapidly sought, and, as a rule, is found at once. It is recognised by the escape of fluid from it, by a thick deposit of lymph around it, or by the constant welling-up of fluid from a particular part of the stomach. As soon as the ulcer is localised, the stomach at that part is drawn well up into the wound, and a few swabs are packed around to prevent any further soiling of the peritoneum. The gap in the ulcer is at once closed by a single stitch which passes through all the coats of the stomach on each side of the perforation. This closes the opening and prevents any further escape of stomach-contents. If the stomach is full,—and it very often is,—it is a good thing at this stage to pass a stomach-tube and empty all the contents away. The stomach may also be gently washed out.

The perforation will often be found surrounded by an area of very dense induration, in which a suture can find little security of hold. This induration is almost entirely due to oedema of the stomach-wall around the ulcer; it is not, as one might suppose from the feel of it, due to any cicatricial induration and contraction in the ulcer itself. Oedema alone causes it, for on postmortem examination of such cases the induration is always found to have vanished. There is no need to excise the ulcer, and this procedure is, in so far, harmful that it wastes a few seconds and causes sometimes not a little bleeding. Excision of the ulcer is, however, performed as a routine measure by some surgeons. The perforation, having been closed by a single stitch, is now effectually sealed by infolding the stomach-wall by a double layer of suture. I always use thin Pagenstecher thread and the curved intestinal needle for this purpose. The first suture begins about one inch away from the ulcer, and continues beyond the ulcer about one inch. The second stitch is applied beyond the first, which it infolds.

In some instances the closure of the gap may be difficult. The opening may be almost inaccessible, being on the lesser curvature, close to the cardiac orifice. In these circumstances the application of sutures in the ideal method just described may be physically impossible. The only plan, then, to adopt is to take one or more interrupted sutures through or outside the ulcer and make a closure of the perforation that will, at the least, be temporarily efficient. To make the sealing-off complete, an omental graft or flap is then applied over the stitches. The left end of the omentum is sought and turned upwards over the stomach, where it can be fixed by one or more stitches. In one case I have adopted this plan with perfect success when satisfactory closure by suture alone was impossible.

The perforation being closed, attention must be paid to the toilet of the peritoneum. The shorter the time that has

elapsed since the giving-way of the ulcer, the less will there need to be done. If the patient is operated upon within the first four or six hours, very little cleansing will be necessary. A few sterile swabs passed to the back of the abdomen, above the lesser curvature, above the liver, and into each renal pouch, will ensure that all is made clean. The abdomen can then be closed without drainage.

If, however, more than twelve hours have elapsed since the perforation, and if gross particles of food are free in the peritoneum greater care and longer time must be spent on ensuring that all is clean. Hot moist swabs are passed into all the nooks and crevices of the abdomen. Especial care must be taken to see that the parts immediately beneath the diaphragm are thoroughly cleansed—for the risk of subphrenic abscess or of a spreading of a septic inflammation through the diaphragm, giving rise to pleurisy or empyema, is by no means inconsiderable. It is absolutely necessary that these upper parts of the abdomen should be left as clean as it is possible to make them. If careful, methodical, painstaking sponging will not suffice, flushing with hot sterile salt solution may be adopted in the worst cases. The kidney pouches, and in most cases the pelvis, need also to be cleansed. If the perforation has occurred more than twenty-four hours before the operation, a very thorough cleansing will be necessary, and in such cases a second incision above the pubes must be made for drainage. Finney suggests the making of multiple incisions for purposes of flushing and drainage, and in advanced cases of peritonitis nothing else is so effective. The question of drainage can be decided only by the surgeon himself in each case. If possible, drainage should be avoided, but in cases of over twelve hours' duration it is probably necessary in at least one-half of them. Drainage, when used, should be free, and, as a rule, I prefer the split rubber tube drain to any other. When the ulcer has been sutured, a careful search must be made for other ulcers which may have perforated. In two cases of my own two ulcers had simultaneously, or almost

simultaneously, perforated. In the first, the two ulcers were exactly opposite each other—one on the anterior, one on the posterior, surface. In the second, the two ulcers were both on the anterior surface, about $1\frac{1}{2}$ inches apart. It has been computed, from a large number of statistics, that two ulcers, or more than two, perforate in 20 per cent. of the whole number of cases. I have already referred to the necessity, in many cases, of emptying the stomach, and perhaps of gentle lavage also. This point is one which I have not seen mentioned in the writings of any surgeon, but it is, I am convinced, an important one.

In all cases of duodenal perforation and in some of gastric perforation the question must arise as to the need for gastro-enterostomy. When an ulcer has perforated, the closure of the resulting aperture is accomplished by folding in the wall of the intestine. In a tube of the calibre of the duodenum, or of the juxtapyloric portion of the stomach this results in narrowing. Even when the suture is made with the finest accuracy, and the stitches inserted along a vertical line, some amount of stenosis is almost sure to follow at once; and in the subsequent contraction of healing this will very probably become more marked. In the first case of perforated duodenal ulcer upon which I operated so great a constriction of the duodenum was produced by the suture that I found it necessary to perform gastro-enterostomy at once. I have since then had to carry out a similar procedure in other cases. It was this experience which first led me to advocate the performance of gastro-enterostomy in all cases where a narrowing of the bowel had been at once produced by the application of the sutures, or where it was likely to be caused in the subsequent contraction which would occur in the process of healing. I was, I believe, the first surgeon to advocate the performance of gastro-enterostomy in suitable cases of perforating ulcer ("Lancet," 1901, ii, 1656-1663).

Other writers have since advocated the routine performance of gastro-enterostomy in all cases of perforation of the stomach,

but my experience has shown that this is quite unnecessary. Gastro-enterostomy is only to be done in those cases where an obstruction is present or is likely to develop from the closure of the ulcer, or where a second ulcer is seen. The advantages of gastro-enterostomy are; that it permits a more assured closing of the ulcer, for the surgeon's mind is not filled with misgivings as to whether his suture may be too widely taken; that it allows of the early unrestricted administration of food; that it avoids the recurrence of the ulcer, or the development of a second ulcer, either of which may perforate.

A. B. Mitchell ("Trans. Ulster Med. Soc.," 1908, i, 68) reports a case in which perforation occurred on July 21, 1907; the ulcer was closed by suture and the pelvis drained; a second perforation occurred on March 5, 1908, and a second operation—closure of the ulcer and gastro-enterostomy—was performed with success. I believe it to be the best practice, therefore, to close the ulcer so efficiently as to cut off the pyloric outlet from the stomach, and to perform posterior gastro-enterostomy (or anterior, if thought better) at once.

As soon as the operation is completed, the patient is given an enema consisting of 10 ounces of saline solution with one ounce of brandy. This is repeated every three or four hours, or a continuous saline injection may be given per rectum (Murphy's method). No fluid is given by the mouth for at least twelve hours, and, if possible, not for twenty-four hours, unless gastro-enterostomy has been performed. In that case any quantity of fluid may be given from the first. The mouth is frequently rinsed, and the teeth are brushed. This will keep the mouth moist, and will lessen the sense of thirst. If needed, subcutaneous or intravenous injections of saline solution may be given.

When the patient has come round from the anæsthetic, she is propped up in bed with about five pillows or with the bed-rest. This semi-sitting posture is necessary as affording drainage of fluids away from the diaphragm, and as

being decidedly more comfortable for the patient. For the first few days a careful note must be taken of the pulse-rate and of the rate of the respirations. The most dreaded complication in cases of this kind is the occurrence of some septic inflammation beneath the diaphragm (subphrenic abscess) or in the chest (pleurisy or empyema). After twenty-four hours the patient may be given sips of water, milk and water, a little wine and water, or tea. It must be remembered that there is need for careful dieting perhaps for some weeks after the operation.

PERFORATING DUODENAL ULCER.

In certain particulars the symptoms and the treatment of perforating duodenal ulcer differ from those of perforating gastric ulcer.

A duodenal ulcer may perforate at once and acutely into the peritoneal cavity, or may slowly destroy all the coats of the bowel and lead to the formation of a localised encysted abscess. If the former, the fluid escaping from the viscus is free to run at large in the peritoneal cavity. In many of the cases, as is seen from a study of the records, a well-defined path is taken. The fluid (generally mucus, more or less tinged with bile) escapes on to the upper surface of the transverse mesocolon to the right of the hillock which is formed by the fitting in of the transverse colon to the greater curvature of the stomach. It, therefore, tends to run to the right to the hepatic flexure, and then to descend along the outer side of the ascending colon to the iliac fossa. There collecting, it may cause symptoms strongly suggestive of appendicitis. From the iliac fossa the fluid drains to the pelvis, and, filling that, overflows into the left iliac fossa. If an abscess forms, it may be bounded by lymph, by the liver, or by intestines. Meunier describes a local abscess in his case as being bounded by the quadrate lobe of the liver, the gall-bladder, and the transverse mesocolon. Lennander relates a case where

an abscess was hemmed in on all sides by intestine. The perforation of such an abscess may lead to acute septic generalised peritonitis, as recorded by Planchard. Perforation of the upper portion of the duodenum may lead to subphrenic abscess. Seven cases of this kind are related in Maydl's monograph. An ulcer may destroy all the coats of the bowel, and its base be formed by the liver (Keyl, Herzfelder, Collin) or by the gall-bladder (Krauss, Moynihan). An ulcer may destroy all the coats of the bowel and perforate a hollow viscus, forming an "internal duodenal fistula." Rokitansky describes a case of gastroduodenal fistula; Hoffman and Gross, cases of cholecystoduodenal fistula; and Duden-sing a case where the ulcer had perforated the pancreatic duct. An ulcer may destroy all the coats and lead to the formation of an abscess, which bursts upon the surface of the body, forming an "external duodenal fistula," as recorded by Lumeau and Bucquoy. The duodenal wall may be ulcerated through by an abscess arising from without, as in the case of lumbar abscess bursting into the duodenum close to the biliary papilla under the care of Davies-Colley.

At the first the **symptoms** of a perforated duodenal ulcer are precisely similar to those seen in cases of perforated gastric ulcer, but after the first hour has passed the symptoms and signs of gastric and duodenal perforation begin to differ in their development. When the ulcer is in the stomach, the signs are those of general peritoneal involvement; when the ulcer is duodenal, the course taken by extravasated fluids leads to a more acute and an earlier involvement of the peritoneum on the right side, and in the right iliac fossa. The clinical picture of appendicitis is copied with such accuracy that in 49 recorded cases tabulated by me in the "Lancet," of December, 1901, in 18 the first incision was made over the appendix after a diagnosis of acute appendicitis had been made. In the final stage, the peritoneal infection is universal.

When the abdomen is examined even within the first one

or two hours, a greater resistance and a more marked tenderness may be found upon the right side, and the tenderness over McBurney's point may be exquisite.

The **diagnosis** rarely presents any difficulty. The symptoms are those of an abdominal catastrophe, occurring in one who has, as a general rule, though not invariably (for an acute ulcer may rupture), exhibited those symptoms of duodenal ulcer which I have shewn to be so characteristic. The pain and tenderness are almost always greater on the right side where also there is a more obstinate rigidity (see my book "Duodenal Ulcer," second edition, 1913, p. 215).

When **operation** is performed, there may be great difficulty in exposing the ulcer. If the ulcer be in the first portion of the duodenum, it is generally easily discovered and easily sutured; if the ulcer is "tucked back," it may be impossible to suture it. Whenever practicable, the perforation should be closed completely in the manner already described. By so doing, the lumen of the duodenum may be greatly narrowed, so that an alternative route from the stomach must be given by the performance of gastro-enterostomy. This was performed in several of my cases.

When the ulcer is so deep that it cannot be sutured, or when sutures however carefully introduced cut out at once, the difficulties of the surgeon are considerable. In such cases the ulcer may be closed by folding the two omenta over it. The gastro-hepatic omentum is drawn over the anterior surface of the duodenum and fixed at its lower border by a few stitches or by ligatures to the gastro-colic omentum, at its attachment to the great curvature of the stomach. The extreme right portion of the great omentum is then turned upwards over the duodenum to form a second protective layer over the gastro-hepatic omentum. This is the method I adopt, in one form or another, in all cases of chronic duodenal ulcer. It is known that even after gastro-enterostomy has been done, a chronic duodenal ulcer may perforate. In all cases therefore at the time the short circuiting operation is performed I join the two omenta together over the duodenum to make a secure covering for it. When an acute per-

foration has occurred and the gap cannot be closed in the ordinary manner, this method of occlusion by borrowing the omentum may prove perfectly satisfactory. To make quite secure, however, it would probably be better in all such difficult cases to close the pylorus also, and to make an alternative route from the stomach by means of gastro-enterostomy. Lennander, Mayo Robson, and others advised that in such cases a tube surrounded by gauze should be carried down to the ulcer, so that a channel might form from the perforation to the abdominal wall. In

Fig 40. Mode of closure of duodenal ulcer, whether perforating or not. The ulcer is enfolded and the gastro-hepatic and gastro-colic omenta are sutured or ligatured together over the intestine.

the case of the stomach this would mean that a gastric fistula would result, which would admit of closure after the lapse of a little time. In the case of a duodenal ulcer such a procedure would almost certainly result in the death of a patient from starvation in a very few days. It is remarkable with what rapidity a patient succumbs who has an external duodenal fistula. It is therefore absolutely imperative in all cases to close the ulcer by suture, by grafting, or plugging with, the omenta, or to close the pylorus and to perform gastro-enterostomy.

CHAPTER XII.

OPERATIONS FOR CHRONIC GASTRIC ULCER, PYLORIC STENOSIS, ETC.—GASTRO-ENTEROSTOMY.

POSTERIOR GASTRO-ENTEROSTOMY.

THE operation of posterior gastro-enterostomy is performed in the following manner:



Fig. 41.—The abdominal incision in gastro-enterostomy; the anterior sheath of the rectus is stripped up to the middle line.

An incision about four inches in length is made about one inch to the right of the middle line above the umbilicus. The anterior sheath of the rectus is opened, and the fibres of the muscle are split, or, as is far better, the anterior sheath is dis-

sected up from the front of the muscle as far as the middle line; the whole body of the rectus is then drawn to the outer side, and the posterior layer of the sheath is incised along a line exactly behind the incision in the anterior layer. The skin is covered by "tetra cloths" attached by the special forceps to the wound edges and ends. The abdomen is then opened.

An inspection of the whole of the stomach is necessary. It may be that an obvious thickening or puckering of an ulcer

Fig. 42. —Incision of the posterior sheath after outward traction of the rectus.

at the pylorus is visible at once, but the surgeon must not rest content with this. A further search must be made on both the anterior and the posterior surface for other points of thickening. Not until the whole stomach has been felt and seen should any operation be performed upon it. Many mistakes have been made from lack of this precaution.

The stomach, transverse colon, and omentum are withdrawn from the abdomen and turned upwards to expose the under surface of the transverse mesocolon. The origin of the jejunum is then sought. Occasionally the first few inches of the jejunum are attached to the under surface of the mesocolon by adhesions possibly physiological, possibly pathological. The meso-colic band, a short ligament springing from the under surface of the

Fig. 43.—The posterior surface of the stomach made to project through the incision in the transverse mesocolon.

mesocolon and attached below to the jejunum, may extend on to the gut for 3 or 4 inches. If it does it should be divided until the jejunum is free up to its origin.

The posterior surface of the stomach is exposed by making an opening through the transverse mesocolon into the lesser sac. It is sometimes not quite easy to divide the transverse mesocolon clearly, and in order to do so I have found the following method of great advantage:

The transverse colon and the stomach are held in the surgeon's left hand, and the mesocolon is made taut. At a bloodless spot in the arch of the middle colic artery a clip is applied to the under surface of the mesocolon, and, having secured a firm hold, it is pulled away from the posterior surface of the stomach. A snip of the scissors by the side of the clip opens the lesser sac at once. The opening is enlarged by gentle stretching and tearing until three fingers can readily be passed through it. Through this opening the whole of the posterior surface of the stomach is explored. Adhesions may be found between the stomach and the mesocolon or between the stomach and the pancreas, and it may be that these are so dense as to preclude the possibility of the performance of the posterior operation.

Fig. 44.—Moynihan's clamp for gastric and intestinal operations (made by Down Brothers, London).

The inspection and investigation of the stomach being complete, the anastomosis may be made. It is essential to see that the part needed for the anastomosis is brought through the opening in the transverse mesocolon. This part consists of a vertical fold in line with the vertical portion of the lesser curvature and also with the right margin of the œsophagus, and it ends below at the lowest point of the greater curvature. A fold of the posterior surface along this line is then seized by the surgeon and drawn well out of the ab-

domen. As the fold is held in the fingers of the left hand, it is embraced by a clamp held in the right and applied vertically, the tip of the blades pointing to the chin, the handle pointing to the pubes. The amount of stomach held in the clamp should be 3 or 4 inches in length. The clamp is then turned transversely, the handle pointing to the left side of the abdomen, where it is held by the assistant.



Fig. 45. —Gastro-enterostomy. The strip of gauze between the clamps.

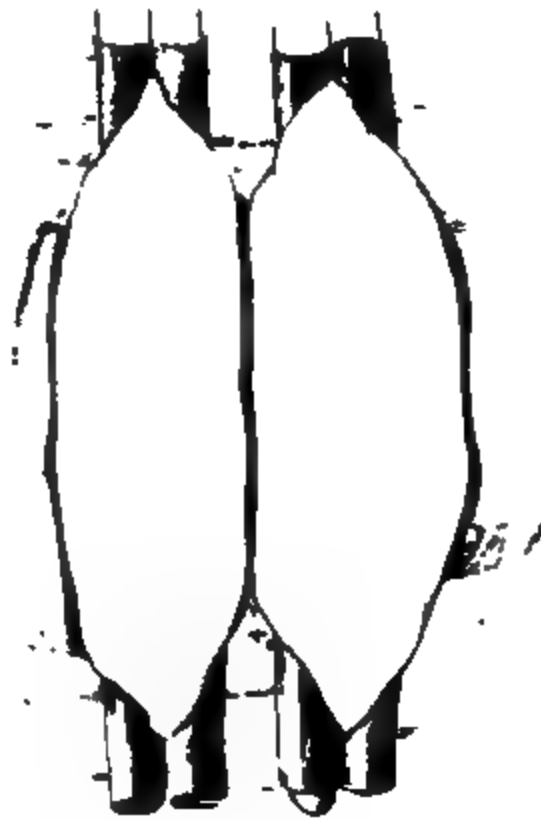


Fig. 46. —The clamps completely surrounded by mackintoshes; all the viscera within the abdomen.

The uppermost portion of the jejunum, which has been held up to this point by the assistant, is now drawn well out of the abdomen and clamped. The clamp is applied by the assistant, while the length of gut is held by the surgeon. When the clamp is in position, and before it is locked, the jejunum at the proximal end is pulled forwards so as to make it as taut as possible, while the clamp held by the assistant is depressed. This secures that the clamp is applied as close to the flexure as possible.

The two clamps are now holding the portions of stomach and intestine to be anastomosed. The upper clamp holds a fold of the stomach $3\frac{1}{2}$ to 4 inches in length; the lower, a portion of jejunum of the same length. The portions of stomach, omentum, and trans-

Fig. 47.—Gastro-enterostomy. The clamps in position; the viscera returned within the abdomen; the swabs placed in position. The suture is now commenced.

verse colon outside the abdomen are now returned, so that no viscera remain exposed except those to be engaged in the anastomosis.

The two clamps are now held apart; a roll of moist hot gauze

is placed between them; over this they are placed as closely together as possible, and around them two mackintosh cloths are placed, so that nothing is now visible but the two clamps embracing the viscera about to be united. It is an important feature of this operation that there is no undue handling or exposure of any part of the abdominal contents.

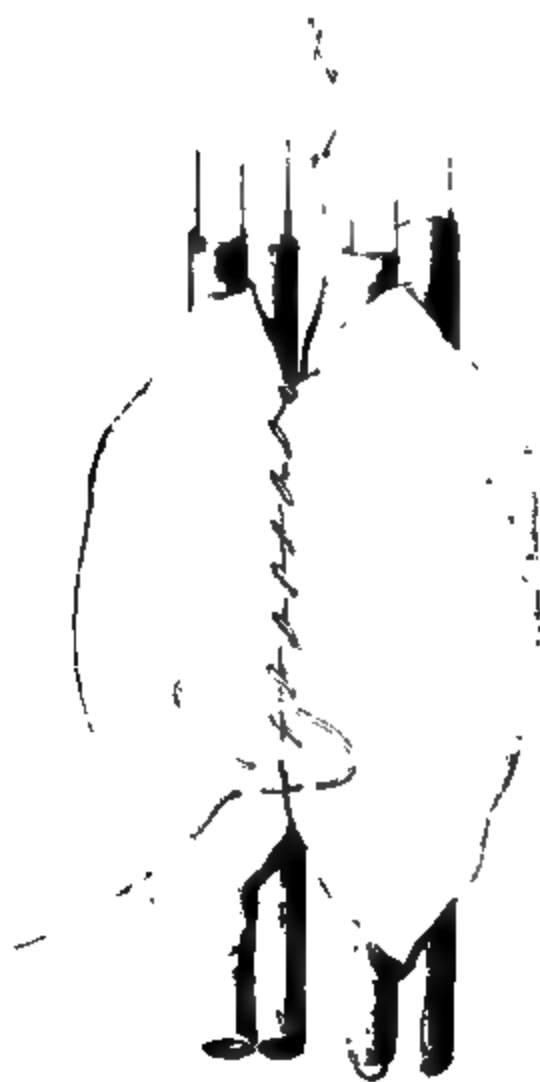


Fig. 48 —The first layer of serous suture.

Fig 49.—Removal of the ellipse of mucous membrane.

The sutures are now introduced; they are all continuous, and there is no interruption by knotting at any part of their course; a needle of my own pattern (made by Down Brothers, London), rather more than half a circle in length and with a rounded body and a slot eye for easy threading, is used, and thin Pagenstecher (celluloid) thread is employed throughout. The first stitch picks up the serous and muscular coats only.

It is commenced at the left end of the portions of stomach and jejunum enclosed in the clamp, and is continued until the greater curvature of the stomach, at the right end of the clamp, is reached. The length of the sutured line should be at least two inches; its average length is between two and three inches. The individual stitches are placed about one-

1

Fig. 50. -The beginning of the suture, which embraces all the coats; Allis's forceps in position.

eighth of an inch apart, and the thread is drawn upon sufficiently to ensure an easy approximation of the serous surfaces. As each passage of the needle through jejunum and stomach is completed, the suture is pulled upon gently, so that, at the same time, the thread just introduced is tightened and a little ridge or fold of each viscus is raised up, making clear the exact position for the passage of the needle next time. When the first row of the stitch is complete, the needle is

laid aside, to be used against a later stage of the operation. On either side of this row at a distance of $\frac{1}{4}$ inch an incision is now made into the stomach and jejunum, the serous and muscular layers of each being carefully divided until the mucous membrane is reached. Before the opening is made a few pieces of moist gauze are packed round the clamps to catch any discharge or blood which may escape. As the cut is made the serous coat

Fig. 51.—The inner suture, continued.

retracts and the mucous layer pouts into the incision. An ellipse of the mucous membrane is now excised from both stomach and jejunum, the portion removed being about $1\frac{3}{4}$ to $2\frac{1}{2}$ inches in length, and rather more than half an inch in breadth at the centre. The gastric mucosa shews a marked tendency to retract; it is, therefore, seized, together with the serosa, in a pair of miniature (French) vulsella on each side. No vessels are ligated, as a rule. The cut surface of the bowel and stomach may

occasionally ooze slightly; this can be checked at once by tightening the clamps one notch. An Allis's forceps is placed on the posterior cut edges of the incision, picking up the mucous and serous coats of the stomach and the serous and mucous coats of the jejunum. It is placed at or near the end of the incision, near the operator, and is allowed to hang down. Its weight is sufficient to keep the cut edges now to be sutured in apposition and to make them fairly taut. The inner suture is now introduced. It



Fig. 52. — The inner suture nearly completed. The mucosa being turned outwards, not inwards.

embraces all the coats of the stomach and jejunum around the whole circumference of the opening. The needle is first passed through the wall of the jejunum from the mucous to the serous surface at the left end of the incision, and then from the serous to the mucous surface of the stomach at a corresponding point; the knot, when tied, is on the mucous surface. The needle is now passed, time after time, from the mucosa of the jejunum to the mucosa of the stomach, picking up both serous coats in its passage. The stitch is drawn

tight enough to constrict any vessels in the cut edges, and as it is so drawn the point for the next introduction of the needle is made clear. When the stitch has been completed along the hinder margin of the incision, it is returned along the anterior margin, without interruption until the original end of the stitch, left long, is reached, when a triple knot is tied and the ends of the suture are cut short.

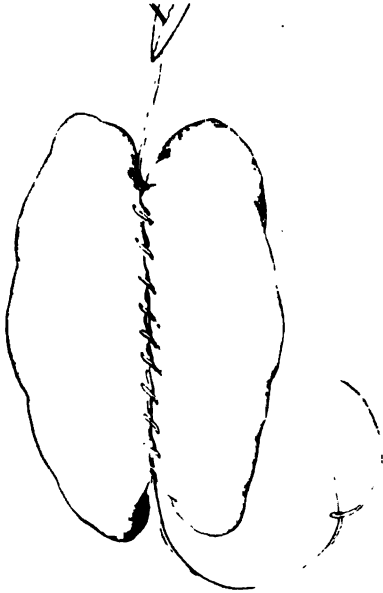


Fig. 53.—The inner suture completed; the clamps removed to shew if there are any bleeding points.



Fig. 54.—The serous suture resumed.

The clamps are now loosened but are left in position in order to prevent the viscera from slipping back into the abdomen. If any bleeding vessel is seen, it is clipped and ligatured. The parts are wiped over with hot moist swabs, and all instruments used up to this point are discarded. This is done on the assumption that the mucous membranes of the two viscera may contain micro-organisms. As a matter of fact, organisms are almost invariably absent if the plan of preparation of the patient, elsewhere described, is followed.

The original serous suture is now continued. The needle which was laid aside is used again. The only difficult part of the stitch is now encountered, for there are many vessels along the greater curvature of the stomach and near it which have to be avoided, and unless the utmost exactness is observed, a vessel may easily be wounded. If it should be, a deeper and wider stitch must be passed, and tied with sufficient firmness to check the bleeding. The suture is drawn

Fig. 55.—Termination of the serous suture; the final stitch overlapping the first one.

upon with moderate firmness, with the result that the place for the next introduction of the needle is made plain. When the stitch has been carried around to the point from which it originally started, the end of the thread left long is taken in the fingers; with it the stomach and jejunum are dragged gently upwards, and beyond it the needle is passed once before being tied. This is well shewn in the figure (Fig. 55). This affords an extra security at a point which might other-

wise be weak. The ends of the stitch are knotted and cut short. Before inserting the last two or three stitches, it is well to remove the clamps in order to relieve the slight tension of the jejunum especially; a greater security is, in this way, given to the apposition at the termination.

The suture lines are now complete. The inner one embraces all the coats and is hæmostatic; the outer one includes the serous and muscular coats, and affords a wide approximation of surfaces.

The stomach and jejunum are now wiped over gently with

Fig 56.—The roll of gauze behind the anastomosis when pulled from side to side displays all parts of the suture line.

hot moist swabs, and the mackintosh removed. A strip of gauze, it will be remembered, was placed in between the two viscera before the clamps were brought together. The end of this near the surgeon is now raised up and turned towards the left side of the patient. The result of this is that the under, or opposite, side of the anastomosis is disclosed, and it can then be seen if the suture line is satisfactory. This part also is gently swabbed. If any part of the suture line seems weak, a separate stitch may be introduced—this, however, is practically never necessary. The gauze strip is now removed, and the

transverse colon and the stomach, which were replaced in the abdomen before the stitching was commenced, are now withdrawn. In the surgeon's left hand the middle of the transverse colon and the lower part of the stomach are grasped, and are drawn gently away from the posterior wall of the abdomen, while, with the right hand, the portions of viscera at the anastomosis are adjusted in the opening made in the transverse meso-

Fig. 57.—The suture line complete. When the stomach and jejunum are held up the latter is seen to descend directly from the flexure on to the stomach, F, in the duodenojejunal flexure. (After W. J. Mayo.)

colon. A clip is now placed upon the edges of this opening on the left side, and a suture is passed between this point and the jejunum just outside the line of stitches at the anastomosis. The same is done on the right side, and also at the lowest point (that nearest the transverse colon) of the opening. These three stitches hold the transverse mesocolon in contact with the jejunum all around the line of the sutures. In this manner additional security, if such were necessary, would be given to the suture line; and,

further, a hernial protrusion of the small intestine into the lesser sac of the peritoneum is prevented. I prefer to stitch the mesocolon to the jejunum rather than to the stomach, as is generally done. The stomach, colon, and omentum are now replaced and the abdominal wound is closed.




Fig. 58.—The suture of the edges of the opening in the mesocolon to the line of anastomosis.

I have used the above method in approximately 350 cases of gastro-enterostomy in simple and malignant disease. In only one case have the mechanics of the operation been at fault, and that was in an early case, when no sutures were

passed through the transverse mesocolon. The patient died of a hernia of all his small intestine into the lesser sac. The possibility of this is now prevented by the sutures between the jejunum and mesocolon which I have described.

Fig. 59.—The final stitches in gastro-enterostomy, uniting the margins of the opening in the transverse mesocolon to the line of anastomosis.

In all cases of duodenal or pyloric ulcer (especially the former) infolding of the ulcer, as is done in cases of perforation, is desirable. If the ulcer in the duodenum be too large to be infolded the gut should be closed by infolding sutures upon the proximal side of it. After these sutures are tied, the gastro-hepatic

and gastro-colic omenta above and below the duodenum are drawn together by ligature in such a manner as to form an additional protection to the infolded ulcer. It is important to remember that in cases of duodenal ulcer both perforation and hæmorrhage have proved fatal after gastro-enterostomy has been performed.

It will be seen, from the above description, that the method of suture is precisely the same as that which is adopted in most

Fig 60.—Gastro-enterostomy. Shewing the position of the anastomosis on the posterior wall of the stomach. Note the large size of the opening, and the absence of a jejunal loop.

cases of intestinal anastomosis. The fact that the method is one which is widely applicable is, in my judgment, a very strong point in its favour.

The average time for the performance of the entire operation is between twenty-five and thirty minutes. I have on three occasions performed it in less than twenty minutes when the circumstances were desperate. There is no method of gastro-enterostomy which is equally rapid and equally safe.

In not one case have I seen any fault in the suture line when the abdomen has had to be reopened months or years afterwards for other operations, such as the removal of the appendix or for the performance of ovariectomy or hysterectomy.

The following are the chief points to be emphasised:

Fig. 61.--Posterior gastro-enterostomy with a loop; entero-anastomosis is also performed.

1. When the operation is completed and the parts are being replaced, it will be seen that there is no loop in the jejunum on the proximal side of the anastomosis. The gut descends in a straight line from the flexure to the posterior surface of the stomach. Regurgitant vomiting is therefore unknown.
2. The opening in the stomach is vertical.
3. The opening reaches to the very lowest part of the

stomach, on the greater curvature. The formation of a pool of stagnant fluid below the level of the anastomosis is therefore impossible.

4. The removal of the mucosa of the stomach and jejunum, which results in an *opening*, not a *slit*, being made between the two viscera. For thought of this point I am indebted to the Murphy button, which "stamps out," as it were, a portion of the wall of both stomach and jejunum.
5. The large size of the opening; the smaller opening made is almost twice the size of that made by the Murphy button or by a bobbin. The size of the opening, moreover, can be justly proportioned to the size of the stomach. A large stomach necessitates a large anastomosis. With all mechanical aids this cannot be done.
6. Absence of undue contraction in the opening results from the close approximation of the cut edges of the mucous membrane of the two viscera. There is, inevitably, in cases of dilated stomach, some subsequent reduction in the size of the anastomosis; this is in direct proportion to the reduction which occurs in the size of the stomach itself. After a gastro-enterostomy opening has been working for six months in a case of greatly dilated stomach, it will always be found that some reduction in size of the stomach has occurred. The stomach, in my experience, rarely returns to the normal, but a considerable lessening in size is often appreciable. At equal rate does the opening become reduced.

It is a common fault in the performance of gastro-enterostomy that the opening is made too small—often far too small. The minimum length of the opening should be 2 inches; and in those cases when the stomach is greatly dilated, it may well be made twice this length.

7. Suture of the transverse mesocolon to the suture line, both stomach and jejunum being embraced by the stitch which picks up the mesocolon a little distance from the cut edge. The result when the suture is drawn tight is that this cut rough edge is rolled inwards towards the lesser sac.

Fig 62 —Posterior gastro-enterostomy. (Mayo's method)

8. The inner suture, embracing, as it does, all the coats, will, if properly applied, prevent any hæmorrhage into the stomach. The suture must be firmly drawn by the surgeon himself: this important matter must not be, as it sometimes is, left to an assistant.

There have been differences of opinion as to the exact line along which the attachment of the jejunum to the stomach should be made. Surgeons, also, wear their rue with a difference.

There does not in practice seem to be much to choose between the results of one method and of the other: the one essential is that the operation should be practised only in those cases where there is a clear indication of its necessity. Hochenegg advised that in applying the jejunum to the posterior wall of the inverted stomach the bowel should be placed in such a direction that the line of the ascending portion of the duodenum was continued without any break; in this way a no-loop antiperistaltic anastomosis is made. The antiperistaltic method has also been advocated by W. J. Mayo; it has accordingly met with wide adoption, and has been followed by equally satisfactory results.

ANTERIOR GASTRO-ENTEROSTOMY.

The foregoing description applies only to the posterior operation.

If, for any reason, the anterior operation should have to be performed,—for example, on account of adhesions between the posterior surface of the stomach and the pancreas, or of the invasion of the posterior wall by growth, or because the mesocolon is too short,—the same method can be adopted. The only difference is that a point in the jejunum some 15 or 18 inches from the flexure will be chosen for the point of anastomosis, so as to avoid any chance of compressing the transverse colon by an unduly tight proximal loop of jejunum. The method of suture is precisely the same as in the posterior method, but the stomach clamp is applied obliquely in such a direction that the anastomotic opening runs from above downwards and to the left; the degree of obliquity, however, should not be too great. When the jejunum is fixed to the stomach it is desirable to make its attachment extend well above the opening, so that there is no likelihood of kinking of the gut at the upper end. This may be done by making the outer row of sutures extend over a length of 3 inches, while the opening, 2 inches in length, is kept to the lower end. The figure will explain this point.

In the anterior operation an entero-anastomosis is perhaps an advantage. An entero-anastomosis may also be performed after the posterior operation if a loop be left.

In those cases of non-malignant disease in which, for mechanical reasons, the posterior operation would be excessively difficult or impracticable I should myself prefer to perform the anterior operation by Roux's method. In Roux's operation the jejunum is divided completely across about 6 to 9 inches from the flexure; the

Fig. 63.—Anterior gastro-enterostomy; shewing the outer suture embracing a much longer portion of the stomach and intestine than the inner. The greater curvature is at the left of the picture at the tip of the clamp.

distal cut end is implanted into the stomach, and an end-to-side anastomosis performed, and the proximal end is implanted into the side of the distal, about 3 inches from its point of union with the stomach. The anastomosis is made between the posterior surface of the stomach and the jejunum, but can be made equally well with the anterior surface. I have often performed Roux's anterior operation, —the gastro-enterostomy in Y, as it is called,—and the results have been most satisfactory. Indeed, the method is in many respects an ideal one,—

it reproduces more nearly the normal conditions, for the bile and pancreatic juice after this operation are introduced into the bowel about 3 inches from the new opening into the stomach, exactly as in the normal duodenum. Roux's operation is

Fig 64 —Anterior gastro-enterostomy; the operation completed. The extension of the outer suture well beyond the upper limit of the opening is seen. The jejunum is represented as transparent so as to shew the position of the opening.

said to prevent the possibility of regurgitant vomiting, though I know of one case where the vomiting of bile since the operation has been a constant feature. The disadvantage of the operation is that it requires longer time for its performance,

and that in practice the results are not a shade better than, if, indeed, they are as good as, those which follow the ordinary posterior operation.

ROUX'S OPERATION.

The stomach-wall is clamped obliquely so that the tip of the clamp holds the lowest point on the greater curvature, whilst

Fig. 65.—Roux's operation. The jejunal loop to be divided is controlled by a clamp which remains on until both anastomoses are complete.

in the base of the clamp is a portion of the stomach close to the lesser curvature and near the cardia. A long loop of jejunum is then picked up, and its base is secured by a clamp. At least 8 or 9 inches should be the length of the loop whose base the clamp

holds. The loop embraced by the clamp is now divided about 2 inches from the upper clamped end, the cut being extended into the mesentery. The upper cut end of the jejunum is now united to the side of the lower part, just above the place where it is clamped; the union is effected in the ordinary manner by suture. The distal cut end is then united to the stomach as it is held by the other clamp. The anastomoses are both completed before either clamp is removed. There is consequently no soiling of the operation field by gastric or intestinal discharges or by blood.

The operation takes approximately forty-five minutes—that is, at least fifteen minutes longer than the usual operation. I perform a modified Roux' operation in some cases where an anterior gastro-enterostomy is necessary. The method is as follows: A loop of jejunum some 18 inches long is taken, and 8 or 9 inches gripped in the rubber guarded clamp. The jejunum is then divided just beyond the rubber clamp, the distal portion being held by a Parker Kerr clamp. The portion held in this clamp is now closed by a continuous Pagenstecher suture, the stitch being taken at right angles to the blade of the clamp, first on one side, then on the other. On reaching the tip of the clamp the suture is held at either end by the surgeon, while the assistant in a single movement opens the clamp and withdraws it, the surgeon meanwhile drawing the sutures tight. This manipulation closes the gut, rolling its edges inwards; the stitch now returns to its starting-point, where it is tied and cut. After the closure of the distal end of the jejunum in this fashion, an anterior vertical gastro-enterostomy is performed, and lastly the proximal cut end of the jejunum, which has up to this point been held in the rubber guarded clamp, is united by an end-to-side anastomosis with the distal end about 4 or 5 inches below the gastric anastomosis.

It is curious to read in many accounts of the great difficulties encountered in the performance of the operation of gastro-enterostomy and of the infinite number of modifications of one sort or another that have been suggested. In this opera-

tion, as in all others, the key-note of success is simplicity. The great variety of suggestions as to "new methods," many of them uncouth, shews beyond doubt that the principles underlying the operation have not been adequately appreciated.

If the posterior operation be performed in the manner described above, the results, both immediate and remote, will, I venture to say, be satisfactory. There will be no need of

Fig. 66.—Roux's operation complete.

anxiety as to regurgitant vomiting, nor will there be need or possibility of entero-anastomosis, closures of proximal loops, division of the pylorus, and so forth.

COMPLICATIONS AFTER THE OPERATION.

A number of complications occurring after the operation have been recorded. Among these may be mentioned:

1. Hæmorrhage.
2. Regurgitant vomiting.
3. Internal hernia.

4. Separation of united viscera.
5. Formation of adhesions at or near the point of anastomosis.
6. Peptic ulcer
7. Chest complications.
8. Diarrhoea.

1. **Hæmorrhage.** There have been recorded at least three deaths from hæmorrhage within a few hours of the completion of the operation of gastro-enterostomy, and in all the blood has been shewn to come from the incision in the stomach.

Fig. 67.—Position of a patient in bed immediately after the performance of gastro-enterostomy. As soon as the patient comes round from the anæsthetic he is propped up in this way.

The bleeding may be due to improper suturing. Unless ligatures are applied to all the bleeding points in the cut edges of the stomach, the suture must be applied in such a manner as to secure efficient control of the vessels. In two of the fatal cases interrupted sutures were used; this is bad practice. A continuous suture is far more certain to close the cut ends of the vessel; between two interrupted sutures a vessel may bleed unchecked. The best suture is, therefore, a continuous suture which embraces all the coats.

After the inner suture is completed and the clamps are removed, a few moments should be allowed to elapse during which the stomach and intestine are lightly wiped over with a swab wrung out of hot sterile salt solution. This pause in the operation will give time and opportunity to any vessel inadequately controlled to bleed. If a bleeding point is seen, a separate stitch, taking all the coats of both viscera, is passed and is firmly tied.

If the inner suture is applied as I have described, it will be found that the mucosa on the side towards the operator is not turned in towards the lumen, but is turned *outwards*; it therefore remains visible after removal of the clamps, and a bleeding point in it is instantly seen. If the mucosa is turned inwards on this side (the side where the vessels chiefly lie), bleeding may go on unperceived into the stomach. The prevention of hæmorrhage is, therefore, attained by—

- (a) The use of a continuous suture.
- (b) The embracing of all coats of the suture.
- (c) The drawing of the suture firmly and evenly.
- (d) Inspection of the mucosa after removal of the clamps.

A discussion was recently held, inaugurated by Sinclair White, as to the cause of hæmorrhage after gastro-enterostomy. Sinclair White himself was inclined to hold the clamps used in the operation as a responsible factor, believing that after their removal bleeding might occur from points which had been missed by the suture taken through all the coats. The use of clamps was, therefore, deprecated. I cannot agree with this opinion. The clamps are so useful during the operation, keeping the parts in position, preventing the escape of contents, and so forth, that I should be very loth to abandon them. If they are used, it is, of course, very necessary to apply the inner suture with great care, placing each turn of the thread close to those already inserted, and drawing it sufficiently tight to ensure control of any bleeding point. I have personally never had trouble from hæmorrhage with the method I have described. R. C. Coffey relates a very interesting case in which death occurred from a wound in the

stomach inflicted by the clamps. The pressure of the clamps need never be so strong as to inflict injury on the mucosa.

Herczel and a few other writers have recorded cases of death due to hæmorrhage from the ulcer for which gastro-enterostomy had been performed. Unless the origin of the bleeding is demonstrably in the ulcer I should feel disposed to think it more likely that the hæmorrhage had occurred from the incision to

Fig 68 — Post-mortem specimen of stomach mucous membrane in which is shewn a stoma forty-eight hours after a gastro-enterostomy; also a slit in the mucous membrane produced by clamps. Crossing the slit is a vessel which was devitalised by the clamp and which gave way thirty hours after the operation producing a fatal hæmorrhage. [Coffey]

the stomach wall. It is necessary in all operations so to handle the stomach as to do as little hurt to it as possible. If bleeding does occur from the ulcer it is probably due to rough handling.

2. **Regurgitant Vomiting.**—Many theories have been put forward to explain the occurrence of regurgitant vomiting after gastro-enterostomy. The formation of a "spur" at the point of anastomosis has undoubtedly some influence, and has been demonstrated by Chlumskij in certain cases operated upon by Mikulicz. It was formerly thought that the sole cause was the

presence, in the stomach, of bile and pancreatic juice. Riegel, Malbranc, and Weil related cases where a reflux of bile into the stomach resulted in grave symptoms. Billroth remarked upon the serious import of bile regurgitation after gastro-enterostomy. Claude Bernard and others, founding their opinion upon laboratory experiments, considered that bile inhibited gastric digestion. Dastre, in dogs with gastric fistulæ, introduced bile at all stages of digestion, and concluded that the alkalinising effect of the bile was swiftly negated by a copious outflow of gastric juice. No ill effects were noticed either on the digestive powers or on the general health. Oddi, experimenting upon dogs, obliterated the common bile-duct and united the gall-bladder to the stomach. All the bile consequently flowed at once into the stomach, with the result that the animals gained in weight and suffered not at all. Max Wickhoff, Angelberger, and Terrier have performed cholecystogastrostomy for obstruction in the common bile-duct, and Perrin ("Thèse de Lyon," 1901) has suggested the routine performance of cholecystogastrostomy in occlusions, presumably complete and irremediable, of the common duct. These records all shew that the mere presence of aseptic bile alone is insufficient to induce vomiting. Chlumskij has suggested that the regurgitant vomiting is due to the presence of pancreatic juice in the stomach. To settle this point, Steudel undertook a series of experiments upon dogs. He divided the intestine completely across at the duodenojejunal flexure, closed the duodenal end, and implanted the jejunal into the anterior wall of the stomach. The dogs lived and thrived for a time, but died from perforation of the duodenal loop by fragments of bone, which had been eaten and had passed from the stomach through the pylorus.

In the "British Medical Journal" of May, 1901, I recorded the case of a boy, aged six, upon whom I performed gastro-enterostomy for complete rupture of the gut at the duodenojejunal flexure. The torn end of the duodenum was sutured, and, after resection of a few damaged inches, the jejunum was joined to the stomach. As a result, the whole of the bile and the pancreatic juice passed into the stomach. The boy made a perfect recovery, and remained in splendid health until the one hundred and fourth day after the operation. He then became suddenly

collapsed and died in a few hours, death being due to the perforation of the bowel by the Murphy button that had been used for the anastomosis. This case proves beyond dispute the ineffectiveness of bile and pancreatic juice as sole agents in producing regurgitant vomiting.

There are four varieties of misdirected current after gastro-enterostomy:

1. Regurgitation of duodenal contents through the pylorus.
2. Escape of fluids from the stomach into the afferent loop.
3. Escape of fluids from the afferent loop into the stomach.
4. Regurgitation of the contents of the efferent loop into the stomach.

Any one of these establishes the *circulus vitiosus*. Of these four, the third, the escape of duodenal contents from the afferent loop into the stomach, is generally considered the most frequent and the most grave.

Chlumskij ("Beit. z. klin. Chir.," Bd. xx), in discussing the causes of regurgitant vomiting, suggests the following:

1. Formation of a spur. This is certainly the most frequent. When the anastomosis is effected, the two limbs of the loop hang downwards, and a sharp kink, with spur-formation, results at the point of junction.
2. The jejunal displacement may cause a kink at the duodenojejunal junction, and thereby produce an acute obstruction of the duodenum.
3. The mucous membrane of the stomach may form large pouting valves which obstruct the afferent opening.
4. Closure of the anastomotic opening, if the mucomucous stitch is improperly applied.
5. Compression of the efferent branch of the loop by the colon (Doyen).
6. Steudel related a case, operated upon by Czerny, in which the opening in the transverse mesocolon had narrowed and constricted the efferent loop.
7. In the original operation of Wölfler the antiperistaltic implantation of the jejunum favoured regurgitation.

Of the frequency of regurgitant vomiting, the following figures give some indication: In 65 cases operated upon by Czerny, 1 only presented grave symptoms of regurgitation. An entero-anastomosis was performed, and recovery speedily followed.

In 74 cases operated upon by Mikulicz, 7 died of regurgitant vomiting. In 7 cases an entero-anastomosis was performed, and of these, 3 died. In 215 cases of posterior gastro-enterostomy from the Heidelberg clinic, reported later than those of Steudel by Petersen, there was not a single case of reflux vomiting. In 21 cases of anterior gastro-enterostomy an entero-anastomosis was necessary in 3.

A very large number of modifications of the operation of gastro-enterostomy have been suggested, with the hope of preventing reflux. In Wölfler's original operation, performed September 28, 1881, the jejunum was united to the stomach with its proximal end nearest to the pylorus. Von Hacker, in 1885, suggested that the jejunal anastomosis should be made, not on the anterior, but on the posterior, surface of the stomach, which could be reached by tearing through the transverse mesocolon. The point on the jejunum to be utilised for the anastomosis was placed by von Hacker 20 to 25 centimetres from the duodenojejunal flexure; by Kappeler, 40 to 60 centimetres; by Chlumski, 50 centimetres; by Kader, 60 to 80 centimetres. Petersen emphasised the importance of the anastomosis being as near to the flexure as possible. In 1883 Courvoisier performed a "gastro-enterostomie rétrocolique postérieure trans-mésocolique," an operation attended by no satisfactory results, but memorable as containing the germ of the idea which von Hacker utilised in his method. In 1892 Jaboulay suggested, and in 1894 performed, the operation of gastroduodenostomy; Kümmell, in 1895, independently suggested the same procedure. Mikulicz and Villard strongly commend the method. Kümmell divided the duodenum completely, closed the proximal end, and implanted the distal into the stomach. Jaboulay united the anterior wall of the duodenum to the anterior wall of the stomach, folding the duodenum forwards over a hinge formed by the pylorus. Villard described his method under the title "gastro-duodénostomie sous-pylorique." Instead of folding the duodenum over on to the stomach, he anastomosed the adjacent surfaces of the stomach and duodenum. Brenner introduced a retrocolic, anterior gastro-enterostomy. A loop of the jejunum was passed through a rent in the transverse mesocolon, and then pulled forwards through the omentum just below the greater curvature of the stomach, and united to the anterior wall.

In 1887 Rockwitz drew attention to the fact that in the operation of Wölfler the current in the stomach was opposite in direction to that in the duodenum. To ensure an isoperistalsis he suggested that the proximal end of the loop should be fixed towards the cardiac end and the distal towards the pyloric end of the stomach. In 1898 Roux, of Lausanne, performed his method of "gastro-enterostomy in Y," adapting to this operation a method that had been practised in 1892 by Maydl for jejunostomy. Roux divided the jejunum completely across, implanted the distal end into the stomach and the proximal into the side of the distal.

The operation of entero-anastomosis was first suggested in 1890 by Lauenstein, who advised that the afferent loop should be united to a neighbouring coil of intestine. In 1892 Braun and Jaboulay performed entero-anastomosis between the afferent and efferent loops. Doyen performs a gastro-enterostomy in Y which is similar to that adopted by Roux, but is anterior instead of posterior, and the approximations are made side to side and not end to side. His method is considered by Lücke to be the best of any method yet suggested. It is practically a gastro-enterostomy, an entero-enterostomy, and a resection of the afferent loop combined.

Several methods of narrowing the afferent loop with the hope of preventing its filling with stomach-contents have been suggested. Wölfler surrounds it with a circular stitch; Chaput packs round it with iodoform gauze; and von Hacker makes a series of longitudinal pleats in it. Tavel has shewn that in his patient after a few weeks no trace of a fold could be discovered.

Several methods of preventing misdirection of the stomach have been carried out; the methods are usually described as "gastro-enterostomy by invagination." Faure invaginates a cone of the stomach into the distal segment of the anastomosed loop. Sonnenburg sutures the edges of the stomach incision, leaves the threads long, passes them into the jejunum at the opening for the anastomosis, and out by a second opening a couple of inches distal to this. By drawing now upon the sutures the stomach is pulled well into the jejunum. Rutkowsky, Witzel, and Kader have combined the operations of gastro-enterostomy and jejunostomy, passing the tube into the

stomach and through the gastro-enterostomy opening into the distal segment of the duodenum.

The attempted formation of a valve at the new opening, suggested by Wölfler in 1883, has been carried out most effectively by Kocher, who makes a semilunar incision in both stomach and intestine, the convexity being upwards.

Hadra, in 1891, was the first to suggest that the loop of the bowel united to the stomach should be attached to it both above and below the opening, so that it should be suspended from the stomach by a wide attachment. In this manner the formation of a spur would be effectually prevented. Lauenstein, in 1896, suggested the suspension of the gut only on its proximal side.

The whole question as to regurgitant vomiting has, however, receded into the background in my experience. I never see it in any case of mine now, nor have I seen it in the last few hundred cases. I believe regurgitant vomiting to be due usually to a mechanical defect in the operation, a defect which consists mainly, if not solely, in the leaving of a loop of jejunum between the flexure and the anastomosis. This loop becomes "water-logged": the bile and pancreatic juice distend it, being unable to escape from it easily into the distal limb. Regurgitation through the pylorus then occurs; or the weight of the heavy loop causes a kink at the anastomosis which closes the entrance to the distal limb. In some cases post-operative adhesions distal to the opening may be the cause of that obstruction which is invariably present in cases of "regurgitation."

Bartlett ("Interstate Medical Journal," April, 1907) records a case of posterior gastro-enterostomy of the "no-loop" variety, but with an oblique iso-peristaltic anastomosis which was followed by gastric shrinkage. Five days after the operation the patient commenced to vomit, this continuing until he retained absolutely nothing. At the end of two weeks a secondary operation was performed. Bartlett writes:

"The stomach which had been greatly dilated, was now shrunk, and retracted so high up under the ribs, that the greater curvature was higher than the point at which the duodenum passed through the mesentery, hence, the one-inch loop

of jejunum which had pointed downwards at the completion of the first operation now pointed upwards, the bowel being sharply kinked at the suture line."

The afferent bowel was empty, but the duodenum was distended. Bartlett attributes the condition to "too perfect gastric drainage."

Treatment.—The treatment of regurgitant vomiting in the serious cases must be by operation; an entero-anastomosis must be performed. In the slighter cases relief is often afforded in a remarkable manner by lavage of the stomach every twenty-four hours for a few days.

3. **Internal Hernia.**—Several cases of internal hernia following gastro-enterostomy are recorded; some of these have proved fatal, some have been remedied by subsequent operation.

One of my own cases proved fatal. The following are the notes:

The patient, a male aged twenty-eight, was seen on October 30, 1902. For fourteen months he had suffered from indigestion. At the onset he had an acute attack of indigestion lasting five days; occasional vomiting then, but no blood. He fainted several times, and had tarry motions. During the last three months he had become progressively worse, and lost over a stone in weight; had constant pain after food and occasional vomiting. He could take only fluids, and was "wearing down" fast. The stomach was moderately dilated. Free HCl present. Old blood was noticed in the stools in infirmary almost daily. At the operation duodenal and gastric ulcers were found; duodenal ulcer in first portion about the size of a threepenny-piece, very hard, and slightly adherent. A scar was found on the posterior surface of the stomach near the pylorus. The patient died on the tenth day of acute intestinal obstruction. At the postmortem examination it was found that there had been a hernia of almost the whole of the small intestine through the rent made in the transverse colon, and that the herniated bowel was tightly strangled at the opening.

Dr. W. J. Mayo has recorded ("Annals of Surgery," August, 1902) a case; the following is an extract from his description:

"Abdomen re-opened. Gastrojejunal orifice nearly obliterated and stretched to an inch in length. Jejunum twisted at the site of anastomosis one-half turn from the left to the right. Somewhat more than one-half of the small intestine had passed through the loop of jejunum, between the origin of the jejunum and the attachment to the stomach. The point of entrance was on the right side, beneath the transverse colon. The traction weight of the intestines upon the mesentery at the inferior margin of the loop had caused the volvulus. The mesentery at this point was much thickened; the intestines were replaced, the gastrojejunal fistula divided, and the opening into the stomach closed. The opening into the jejunum was enclosed by a purse-string suture, and the half of a Murphy button was introduced and a posterior gastrojejunostomy made. The pyloric stricture was nearly complete, the ulcer evidently cicatrised. It is probable that the part of jejunum immediately below the anastomosis passed through the loop first, producing the twist which was so prominent a feature on opening the abdomen. As to when this happened, it is hard to tell—probably not for some months after the operation. When the process once began, it might be expected to continue until such an amount of intestine travelled over the loop as to pull the mesentery taut, the symptoms increasing as the condition gradually developed. It is possible that at the time the juncture was effected a slight twist might have occurred.

A similar case is recorded by Dr. Gray, of Aberdeen ("Lancet," vol. ii, 1904, p. 526):

The patient, an unmarried woman, aged thirty-one years, was seen by me in consultation on the evening of May 15, 1904. For some months she had suffered from severe "indigestion," intense epigastric pain, radiating to the back, occurring almost immediately after taking food. She had not vomited during this period, but had noticed that the stools were very dark on several occasions. On May 14 she became suddenly collapsed and vomited a large quantity of blood. In spite of medical treatment the hæmatemesis was repeated several times, although not to such a large extent. The bowels were opened and the stool contained a large quantity of blood. On the evening of the fifteenth she became again so collapsed that death was thought to be imminent. She had recovered somewhat before

I saw her. Her pulse was very feeble and irregular. It was occasionally as low as 120, but was usually considerably quicker. It was estimated that she had vomited between two and three pints of blood. By percussion of the shifting dulness, limited to the gastric area, it was found that the stomach contained at least a pint of blood. Nothing had been given by the mouth since the onset of the attack. These facts, considered along with the presence of the large quantity of blood in the stool, made the total blood lost amount to probably between four and five pints. It seemed that the bleeding had stopped and it was thought advisable to wait until the morning, as transference to hospital would have had a severe effect on the patient in her perilous condition. Morphine was given hypodermically and a careful watch was set. She passed a fairly good night, but early the next morning she again vomited blood and was removed to hospital. On arrival there she vomited a small quantity of fresh blood, so an operation was carried out at once.

Chloroform was administered, and three pints of saline solution were slowly infused into a vein at the elbow. The stomach was exposed by a free incision. Blood was seen to be present in large amount in the stomach and in the whole length of the intestines. Nothing else abnormal about the stomach was detected by inspection or palpation. The blood was squeezed through the pylorus, the stomach was opened posteriorly, and its interior was inspected. No ulcer was seen. A posterior retrocolic gastro-enterostomy was performed. Sutures alone were used.

The patient vomited early on the second day after operation. The vomit contained a small amount of "coffee-ground" material and was foul smelling. Five minims of liquid extract of cascara sagrada were given every hour, but after three doses she became sick, so it was intermitted for twelve hours and then begun again. An enema was given on the evening of the day of operation to clear the rectum; a tarry motion resulted. Every second day thereafter an enema was administered. On the fourth day the stool was free from blood.

About noon on the sixth day she complained of intermittent griping pain in the abdomen. This continued until the evening, when it abated somewhat. It was thought probably to be due to flatus, although previously to this a turpentine enema brought

away neither flatus nor fæces. A small dose of morphine was given. She was quite comfortable until 3 o'clock on the morning of the seventh day, when the pains began again and increased in severity as the effect of the morphine passed off. Vomiting occurred on two occasions. At 9 A. M. another turpentine enema was given, but with no result. The facial expression was now somewhat drawn and anxious. Vomiting continued at intervals, but the pains subsided considerably after the enema. The temperature and the pulse were unaffected. The latter had become reduced in frequency from 144 on the day of operation to 100 to 110.

Intestinal obstruction was diagnosed, and immediate operation was advised. This was declined. I prescribed two drachms of magnesium sulphate by the mouth and eight minims of liquor strychninæ hypodermically. The immediate effect of this was to produce severe colicky pain and acquiescence in operation, which was carried out at 4 P. M. It was then found that practically the whole of the small intestine had insinuated itself from left to right through the ring formed at the first operation by the peritoneum of the under layer of the mesocolon, that lining the posterior abdominal wall and forming the upper layer of the mesentery, and completed anteriorly by the gastrojejunal junction. It was easily pulled back and the ring closed by suturing the under layer of the mesentery to prevent recurrence of the hernia. Strangely enough, there was enormous distension of the colon with gas. It was found to be quite patent down to the rectum. It was accordingly punctured by a trocar and canula and the gas let out. A silk suture was inserted to close the opening made by the trocar, and a piece of omentum was stitched over that. The gastrojejunal junction was found to be perfect. The patient vomited once during the evening after operation, but thereafter recovery was uninterrupted, and she left the hospital on June 13. She was seen on July 5, when she looked extraordinarily well. She had suffered no pain, no indigestion, and no vomiting since her dismissal. The stools had been normal. She now made no restrictions in her diet.

A case is also recorded by Mr. Barker:

Under chloroform an incision was made in the middle line below the umbilicus. Slipping the finger in under the scar,

not a trace of adhesion to it could be found. The wound was then enlarged upwards through the old scar, which was perfectly firm. Some free ascitic fluid now ran out, and dark, distended coils of small intestine presented on both sides. The transverse colon was sought for and drawn out and was found

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Fig. 69. —A, Afferent jejunum coming out from under the plica duodeno-jejunalis (B); C, termination of the afferent duodenum dragged back to the hidden anastomosis, from which (D) the efferent jejunum is passing in its turn over the afferent portion (A to C); G, last part of the ileum twisted round the efferent jejunum and terminating in (I) the end of the ileum at the ileocaecal valve; H, distended coils of the jejunum in the general cavity of the abdomen; K, coils of the ileum in the general cavity of the abdomen. It is seen from this diagram that the *whole* of the small intestine with the exception of the first and last seven or eight inches passed behind the gastro-enterostomy junction and was strangulated over the afferent portion, where it formed a large volvulus (Barker).

to be pale and much contracted. Search was then made for the gastro-enterostomy junction, but it could not be clearly made out. With the finger I could feel the plica duodenojejunalis at the root of the left side of the mesocolon, but the direction of the first part of the jejunum was not clear. On the

right side of the middle of the mesocolon small intestine was felt passing under some tightly constricting mass, and on drawing the coils aside the last seven or eight inches of the ileum, tense and contracted to the size of the little finger, were seen ending in the normal cæcum and twisted on its own axis. Following this back it was seen to pass behind the gastro-enterostomy junction and to be twisted on itself at the point of constriction. It was now plain to all present that the whole of the small intestine with the exception of the last seven inches or so had passed between the junction of the stomach and jejunum and the root of the mesocolon made two years ago, and over the first part of the jejunum (A) (afferent), and then down into the general cavity of the peritoneum. But not only this, the whole small intestine having thus passed, formed a huge volvulus, turning on its mesentery in a direction contrary to the movements of a clock. When this was recognised, the coils as a whole were lifted up and untwisted one complete turn in the direction of the movements of the hands of a clock. Only then could the last part of the ileum (I) be withdrawn from under the constriction, all previous efforts in this direction having failed. But when the volvulus was untwisted, it, and all the rest of the small intestine above it, could be easily and rapidly drawn out. The junction with the stomach could now be plainly seen, and both the afferent and efferent loops; the coils were washed with normal saline solution (warm) and the abdomen was closed. The operation lasted sixty-five minutes and was well borne. Convalescence was uninterrupted and primary union was found when the stitches were removed on the eighth day.

A case of internal strangulation following gastro-enterostomy was related before the Royal Academy of Medicine in Ireland by Mr. Gordon ("Lancet," 1905, vol. ii, p. 1477). A loop of the bowel had passed from right to left above the proximal loop of the jejunum, there becoming strangulated. A second operation was necessary to relieve the obstruction, and was successful.

In addition, a case of my own has been operated upon a second time, and a hernia through the opening in the transverse mesocolon discovered.

All the forms of hernia can be prevented by attention to two points:

- (a) The suture of the edges of the opening in the mesocolon to the stomach, or, preferably, to the jejunum.
- (b) The avoidance of a loop of jejunum between the duodenojejunal flexure and the anastomosis.

4. **Separation of the united viscera** has occurred only after the use of mechanical appliances, and as these are no longer necessary, this complication is negligible. With the suture it does not occur.

5. **The formation of adhesions** around and about the anastomosis is very rarely seen. As a result of them, a constriction of the jejunum may result, and vomiting, due to high intestinal obstruction, will occur. I once operated upon a patient, upon whom gastro-enterostomy had been performed by another surgeon, on account of persistent vomiting. The distal loop of the jejunum was buried in dense adhesions, which reduced the calibre of the bowel to approximately a quarter of its former size. The proximal loop was greatly distended. A somewhat similar case is recorded by F. B. Lund ("Boston Med. and Surg. Journal," May 11, 1905, p. 549).

It is not improbable that the tendency to the formation of adhesions is due to infection at the time of operation.

6. **Jejunal and Gastrojejunal ulcer.**—Now that we have arrived at a stage in the development of the surgery of the simple diseases of the stomach and duodenum in which we are entitled to say that many of the technical difficulties have disappeared, and that almost all our anxiety as to the immediate result of an operation has long been allayed, we are chiefly concerned to discover the remote destiny of our patients. Enquiry assures us that when gastro-enterostomy is now performed in suitable cases, the immediate mortality is very low, certainly less than 2 per cent., and the ultimate condition of the very great majority of the patients most satisfactory. In connexion with the operation there remains only one serious complication to be faced, that is, the development of a new ulcer in or near the site of the anastomosis made between the stomach and the jejunum. Of the history of this condition of jejunal or gastrojejunal ulcer, since its first recognition by Braun in 1899, it is not necessary to speak here. A very full account is

given in several recent articles, the most notable of which is by Van Roojen ("Arch. f. klin. Chir.," 1910, xci, 380); see also Paterson ("Proc. Roy. Soc. Med.," June, 1909, and separate publication), Wilkie ("Ed. Med. Jour.," 1910). Van Roojen gives brief details of 89 cases, and to these three recorded by Wilkie, two cases upon which I have operated, and cases privately related to me by Rutherford Morison, Norman Porritt, and Basil Hall, and others, with the three cases related below, bring the total up to over 100. It is remarkable that so few cases are recorded in American literature, seeing that the development of the surgery of the stomach has been so active in that country. It is almost certain that if they had occurred they would have been reported.

Ulceration at the line of suture, or in the jejunum very close thereto, occurs almost exclusively after operation for simple disease. In only one case in the literature was the gastro-enterostomy performed for carcinoma; this is recorded by Axel Key out of the practice of Lennander ("Nordisk. Med. Arkiv," 1907, xl, 97). The patient was a woman, aged twenty-five, who had a tumour of the pylorus for which resection followed by anterior retrocolic gastro-enterostomy was performed. The patient died on the tenth day from peritonitis. An examination of the specimen proved the growth to be carcinomatous. In the distal limb of the jejunum were found two small round "perforating" ulcers, 20 mm. and 37 mm. from the anastomosis. In every other case recorded the disease was non-malignant. The ulcer may be single, or there may be two, three or four ulcers. As a rule, the ulcer lies close to, and is exactly on the line of, the anastomosis, but sometimes it may be an inch or two away in the bowel, at either side of the anastomosis. In 58 cases Van Roojen found the position to be—

In the closest proximity to, or exactly upon the suture line in . .	46
In the proximal limb of the jejunum in	6
In the distal limb of the jejunum in	8
In or near the point of an entero-anastomosis	2

The ulceration occurs after every form of gastro-enterostomy. The following list is given by Van Roojen:

Anterior gastro-enterostomy.....	29
Anterior gastro-enterostomy with entero-anastomosis.....	12
Anterior gastro-enterostomy in "Y".....	10
Anterior gastro-enterostomy retrocolic.....	1
	<hr/>
	52
Posterior gastro-enterostomy.....	20
Posterior gastro-enterostomy with entero-anastomosis.....	1
Posterior gastro-enterostomy in "Y".....	3
Posterior gastro-enterostomy antecolic in "Y".....	1
	<hr/>
	25

It would appear from this that twice as many cases of jejunal ulcer have occurred after the anterior as have been known after the posterior operation; but we have no knowledge of the relative frequency of the adoption of these two methods. Van Roojen, in order to investigate this question with a nearer approach to accuracy, collected the details of 613 cases of gastro-enterostomy in which 10 cases of jejunal ulcer had occurred. There were 189 cases of anterior gastro-enterostomy with 6 cases of jejunal ulcer, and 444 examples of the posterior operation with 4 cases of ulcer.

The time at which the ulcers appeared is given in the following table from Van Roojen:

Within ten days in.....	3 cases
Ten days to three months.....	5 "
Three months to six months.....	9 "
Six months to twelve months.....	10 "
One year to one and one-half years.....	9 "
One and one-half years to two years.....	6 "
Two years to three years.....	5 "
Three years to four years.....	8 "
Four years to five years.....	4 "
Five years to ten years.....	6 "
Ten years and later.....	1 case
	<hr/>
	66 cases

Dr. Norman Porritt has kindly furnished me with the notes of a case in which two perforations occurred, one in a jejunal ulcer, and one in an acute ulcer on the lesser curvature of the stomach, six days after the operation of gastro-enterostomy.

J. S., tailor, twenty-nine, suffering from pyloric stenosis. Posterior gastro-enterostomy performed 4.30 P. M. on May 7, 1906. Did well until 6 A. M. May 13th, when he had a slight abdominal pain, followed by very severe attacks of pain at 2 P. M. and 6 P. M., followed by abdominal distension and rigidity. Operation May 14th, 5.30 P. M. The abdomen was re-opened through the original incision. Dark, bilious looking fluid found free in abdomen. The anastomosis lay far to the left of the middle line sound and perfect. The jejunum was freed from the mesocolon, and in pulling it up gas bubbled from the lesser sac and there was seen a round, punched-out hole in the jejunum from which bilious liquid exuded. The hole was of the diameter of a small lead-pencil. The perforation was closed with a double row of Lembert's stitching, but on account of the bad condition of the patient nothing more was done than a hasty mopping out of the lesser peritoneal sac and the insertion of a broad glass tube by a stab incision above the pubes and a gauze drain down to the perforated ulcer. As soon as the glass tube reached the pelvis thick yellow liquid like semi-digested food welled from it. On May 15, 1906, at 3 A. M., the patient died.

Post-mortem Examination.—There was no evidence of old ulceration in stomach or jejunum, but the pylorus was narrowed to a tunnel which would barely admit a lead-pencil. It was thickened all round and the lump left at the operation was now very plainly recognised. The anastomosis between the stomach and the jejunum was sound and good, but on the lesser curvature near the pylorus was a round, punched-out perforated ulcer. The ulcer found and stitched at the last operation was examined. It involved the wall of the bowel farthest from, but opposite to, the anastomosis, and was a simple, punched-out, circular, clean-cut hole.

The cause of the development of a jejunal or a gastrojejunal ulcer has not yet been made clear. It is probably not the same in all cases. It may be the smallness of the opening; a bruising of the edges of the anastomosis, or the development of a hæmatoma in the wall of either viscus as the result of the wounding of a vessel by a needle; the persistent presence of excessive quantities of free HCl; or the tearing and unceasing irritation of an unab-

sorbable inner thread which has only partly been released from the suture line. Van Roojen found that in only three cases in which an ulcer was found at the line of the anastomosis was any trace of thread or silk to be discovered. In a case of Battle's ("Lancet," 1906, pp. 274, 1246) an inner suture inserted thirteen months before was removed from the anastomotic line, but the jejunal ulcer was an inch away. Wilkie ("Edin. Med. Jour.," 1910, ii), in an excellent account of some experimental work conducted to elucidate this question, shews that the union of the mucosa at the line of anastomosis occurs by granulation in about seven days, and he concludes, on evidence that is perhaps a little slender, that "the presence of an unabsorbable suture in the granulation area tends to delay repair." Accordingly, he considers it advisable to employ some absorbable material for the inner stitch. The inner stitch is probably soon discharged: it is the outer stitch which in all probability perforates here and there through the mucosa which is found hanging at the suture line months after the operation.

It seems not unlikely that the occurrence of a jejunal ulcer may be due to a persistence of those causes which first set at work the changes leading to the development of the chronic ulcer for which the gastro-enterostomy was performed. Gastric and duodenal ulcers are probably always secondary, and so far as my own clinical observation goes, they would appear to be secondary to an infection elsewhere, generally within the abdomen, but possibly apart from it, in the mouth, on the skin, or elsewhere. Of all the evident primary causes, those within the alimentary canal are the commonest; of these a diseased condition of the appendix is by far the most frequent. The appendix should, therefore, always be removed when the operation of gastro-enterostomy is being done, and any other infective causes sought, and, if found, dealt with radically if possible.

A search through the recorded examples of this condition shews that four clinical types of ulcer can be recognised:

I. The ulcer develops rapidly and perforates shortly after

the operation. There are only four cases which can be included in this group. The circumstances in all are similar: Gastro-enterostomy was performed for an ulcer at or beyond the pylorus, associated with hyperacidity, which in two cases was intense; the progress for the first few days was satisfactory, then suddenly there was an acute onset of pain, followed by peritonitis and death. In all cases an ulcer just beyond the anastomosis was found, and perforation has occurred into the general cavity.

II. The ulcer develops within a few weeks or months of the operation and the symptoms suggest a recurrence of the ulcer for which the operation was performed, or a stenosis of the new opening. The cases in this group are many. The symptoms are very similar to those which were caused by the original ulcer in the stomach or in the duodenum, for which the gastro-enterostomy was performed; or they can be referred to a mechanical difficulty in the emptying of the stomach. These complaints are attributed to a supposed "recurrence" of the ulcer. Secondary operations were performed for disabling symptoms, for hæmorrhage, or for perforation and peritonitis. In these last instances acute perforation had occurred in a chronic ulcer.

III. The ulcer develops slowly, and insidiously undergoes a "subacute" perforation, with the result that a tumour forms in, or abutting upon, the epigastrium. About two-fifths of all the recorded examples fall in this category. There are not usually any symptoms of which the patient takes serious notice. As a rule, only some trivial discomfort after meals or "indigestion" is noticed; on examination of the patient a distinct tumour is felt. When the abdomen is opened, the jejunum at or near the anastomosis is found adherent, usually to the parietes. On separating the viscera a perforation into the intestine at the site of an ulcer a little below the anastomosis is discovered. The condition, it will be seen, is precisely analogous to that of "subacute perforation" in the stomach (see "Annals of Surgery," 1907, vol. xlv, p. 223).

IV. The ulcer perforates into a hollow viscus. The ulcer is

of the chronic type, and perforation occurs after adhesion to a hollow viscus—either the stomach or the colon.

Treatment.—The treatment of a peptic jejunal ulcer may be beset with almost insuperable difficulties. Much will, of course, depend upon the conditions found at the time of the operation. If an acute perforating ulcer be found, it will probably be enough in many cases to close the ulcer by sutures and by subsequent careful dieting and rest to avoid the recurrence of trouble. In the cases where the ulcer is of the chronic type, and especially in those wherein a subacute perforation has occurred, a resection of the jejunal length engaged in the anastomosis and of the adjacent part of the stomach, followed by the making of a new junction between the stomach and the jejunum at a slightly lower level, will be needed. If the original anastomosis has been of the posterior no-loop variety, then the performance of a resection of the anastomosis is exceedingly difficult, as I have good reason to know. In such a case it is better to cut the jejunum across immediately above its attachment to the stomach, and after resection of the anastomosis to make the new junction after the "Y" method of Roux. If the ulcer should be at or near the anastomosis, and a resection of the kind just mentioned be impossible, then I would suggest the free opening of the stomach by an incision along the anterior surface, in order that access may be gained to the ulcer from the gastric side. Probably then the anastomosis could be pushed from behind through the wound in the anterior wall of the stomach and a resection of the ulcer performed. This method I have several times adopted for the suture or excision of ulcers, apparently otherwise inaccessible, on the posterior wall of the stomach adherent to the pancreas, following Pilcher and Mayo. The operation may be called "transgastric resection or suture of an ulcer."

The following three cases of jejunal ulcer treated by operation have been under my care. The original gastro-enterostomy in Cases 1 and 3 was performed by other surgeons; in Case 2, by myself. In none of the cases was any trace of the original inner

suture discovered. Case I is remarkable for the fact that two operations for the excision of jejunal ulcers were conducted within a period of seven months.

FIG. 70.—CASE I.
The parts removed at the first operation. When viewed in the stereoscope, two ulcers are clearly seen.

CASE I.—Old perforated duodenal ulcer. Posterior gastro-enterostomy. Recurrence of duodenal ulcer. Jejunal ulcer. Excision of anastomosis. Modified Roux's operation.

M., Major R. A. M. C., aged forty-two. In 1892 whilst

abroad had an illness, associated with acute pain over gall-bladder region, pyrexia and nocturnal delirium, which was diagnosed as enteric fever; he was invalided to Malta, where he contracted Malta fever. After return home attacks of acute pain in gall-bladder region kept recurring and were accompanied by vomiting. During the war in South Africa was well, but on way home he woke suddenly one night with a very sudden and acute attack of pain, which did not completely cease for three weeks. During none of these attacks did he have jaundice, hæmatemesis, or

FIG. 71 — CASE 1.

The parts removed at the second operation. An ulcer which was on the verge of perforation is seen.

melæna. During the next two years the attacks of pain kept recurring; pain nearly always occurred two or three hours after food. A diagnosis of gall-stones was made, and operation arranged for in April, 1902. Five days before date fixed for operation a sudden attack of most excruciating pain in the upper abdomen, which persisted until the operation was performed. The condition then found was a perforated duodenal ulcer evidently on the upper and posterior wall, with considerable localised peritonitis. The perforation was closed and the gall-bladder

drained, although so far as can be learned no gall-stones were found.

During the six months following operation he had no trouble, but then he began to have a return of the pain, although it was not quite so definite in its onset after food as before his first operation. There was no vomiting.

In May, 1903, posterior gastro-enterostomy was performed by the same surgeon in London. For six to eight months he was subject to attacks of biliary vomiting; these then ceased, but pain began to recur and lasted for three to four weeks; usually it was relieved by a milk diet.

In 1904 pain was very severe, and a diagnosis of jejunal ulcer was made; he was put on fluid diet for months, with relief. During 1906 and 1907 was much better and had only one or two attacks, which occurred after playing golf.

In July, 1908, passed a very tarry motion but had no pain. In September a much worse attack, with acute pain situated midway between umbilicus and left costal margin. He was in a nursing home under treatment with antilytic serum, which appeared to relieve the pain temporarily. On December 8th he woke at 4 A. M. with a feeling of oppression in stomach, followed by vomiting of between three and four pints of blood; melæna for several days after. Since that time has had saurin treatment, etc., but the pain has kept recurring, most frequently at 2 A. M.

When seen by me in March, 1909, I made the following diagnosis: Duodenal ulcer, possibly jejunal ulcer. Patent pylorus, partial closure of anastomotic opening.

Operation was performed on March 24, 1909. Incision just to right of middle line, close to old incision. The gall-bladder margin of liver and stomach were found to be involved in a mass of tough adhesions which were separated with much difficulty; the omentum and transverse colon were turned up over the anterior aspect of the stomach and were adherent to the anterior abdominal wall.

The parts were defined, and it was found that a large indurated scar was present in the anterior wall of the first part of the duodenum.

The gastro-enterostomy was next examined, and it was found that the opening was patent, but the two limbs of the jejunum were almost parallel up to the anastomosis; a considerable

"loop" was present. After the firm surrounding adhesions had been separated, the anastomosis was carefully palpated, an indurated "knot" was felt on the mesenteric aspect of the gut just opposite the gastro-enterostomy opening. This was thought to indicate a jejunal ulcer, so it was decided to excise the anastomosis. The two limbs were clamped and divided, and the stomach incised with scissors just around the anastomotic opening.

The end of the efferent limb was next closed by suture, and a lateral anastomosis performed between it and the opening already existing in the stomach. The proximal limb was next implanted into the distal by an end-to-side anastomosis. The raw surface left by the ligation of the mesentery was covered in as completely as possible. Duodenal ulcer and pylorus infolded by several sutures. Abdomen closed. The operation was extremely difficult throughout and took two and one-half hours.

October, 1909. Since operation he has not been any better but his pain has been constant both night and day, though varying much in intensity. For example, he had always more when he took any exercise. His pain was localised to a small area, just to the left of the umbilicus, and here he thought he could feel a lump, but no one else has made this out. He finds food of any sort sets the pain going in a few minutes. The pain is a constant hot sensation which never actually leaves him, and which is particularly bad at night. He has been having small doses of morphine at nights since the last operation in June. He has tried olive oil treatment without benefit; the only things that relieve him are strong alkalis and morphine. He has lost a considerable amount of weight of late.

Further operation, October 7, 1909. Incision through right rectus in one of the old scars; a very firm mass of adhesions was met with and much time spent in separating them; at length the site of the last operation was exposed, the "Y"-shaped junction of jejunum being found in good order. The transverse colon was now turned up and the posterior gastro-enterostomy exposed, the lesser sac having been opened and numerous adhesions having been separated. On palpation a hard mass could be felt in the posterior part of the line of suture, with a crater in its centre, and the whole mass being the size of a shilling. It was decided to detach this gastro-enterostomy and remove the loop

of small intestine down to the "Y"-shaped junction, and to do a new anterior gastro-enterostomy. The stomach was closed by two rows of interrupted Pagenstecher stitches.

The "Y"-shaped junction was detached and the lower segment closed so as to reproduce the normal line of bowel. The stomach and transverse colon were turned up and the jejunum followed up to its union with the stomach, and with some difficulty the line of union was defined. In separating the numerous adhesions the jejunal ulcer which had been felt on the posterior surface of the anastomosis ruptured at the bottom of its crater, where it was extremely thin. The anastomosis was detached with a collar of stomach wall, and several blackened Pagenstecher sutures of the last operation were found, mostly in the lumen of the bowel, attached by one end to the wall. The hole in the lesser sac was closed by the portion of mesentery belonging to that portion of jejunum leading from the old gastro-enterostomy to the "Y"-shaped junction; this portion of the gut was now removed. A new anterior gastro-enterostomy was now performed in the usual way, with as short a loop as possible.

CASE 2.—Duodenal ulcer. Ulcer sutured. Posterior gastro-enterostomy. Appendicectomy. Jejunal ulcer. Excision. Mrs. S. Sent by Dr. Edgecombe, Harrogate. Admitted to Nursing Home November 28, 1910. All her life she has had "indigestion," worse of late years. She says it is an aching pain coming on, as a rule, two hours after food; it comes on in attacks lasting some days or weeks; after a few days in each attack the pain comes irrespective of the taking of food, but then food relieves it. She practically never vomits. The attacks have become worse of late, but she had an attack in November, 1909, and not another until a few weeks ago, though in between there is some trouble of a much slighter type. The pain is always worse in winter, and is situated invariably above and to the left of the umbilicus, the area here being very tender. She has not had hæmatemesis or melæna or jaundice, and had not lost weight except in the attacks, gaining it at once in the quiescent intervals.

November 30, 1910. Incision through right rectus. Very well-marked duodenal ulcer one-half inch beyond pylorus at upper margin, causing marked thickening and puckering of duodenum. Stomach slightly dilated. Posterior gastro-en-

terostomy performed and ulcer infolded. Appendix was much adherent, extremely small, and fibrous; it was removed.

Re-admission May 13, 1911. Was operated upon for duodenal ulcer and chronic appendicitis November 30, 1910. For a time she had relief, but soon her symptoms began again "as bad as ever" and of the same type, but the pain was felt lower down in the abdomen, and referred to the umbilicus. Pain one or two hours after food and relieved by food; occasionally pain to the right of the middle line.

Operation May 15, 1911. Incision through old scar. At the lowest part of the anastomosis was a hard white indurated

FIG. 72 — CASE 3.

The parts removed. The gastro-enterostomy opening looks downward and to the right. The ulcer is just seen within the upper opening.

mass involving the transverse colon, with a crater on it, felt through anterior wall of stomach, about one inch long and one-half inch to three-quarters of an inch broad, the whole being plastered down by adhesions. After separation, the crater's base was seen to be formed by transverse colon and transverse mesocolon; the edges were in the line of the lowest point of the anastomosis between the stomach and the jejunum and involving both organs. The whole ulcerated area was cut away. The gap in the anastomosis line was stitched up by a row of interrupted catgut stitches and one continuous outer suture

of Pagenstecher thread. A wide opening free from induration was left and admitted two fingers easily. In September, 1911, the patient wrote to say that she was free from pain, but acting under my instructions was living on a spare dietary, consisting chiefly of liquids.

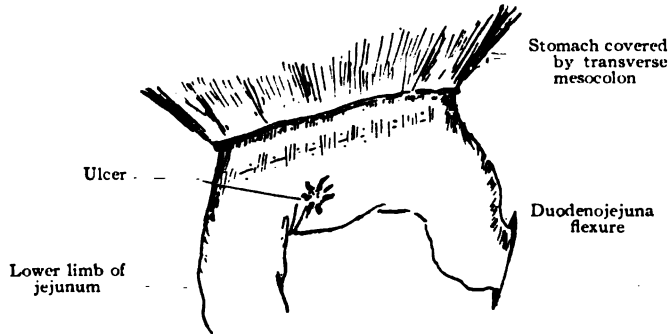


FIG. 73.—OPERATION FOR EXCISION OF THE PARTS IN A CASE OF JEJUNAL ULCER. Step 1. (Drawn by Mr. L. R. Braithwaite.)

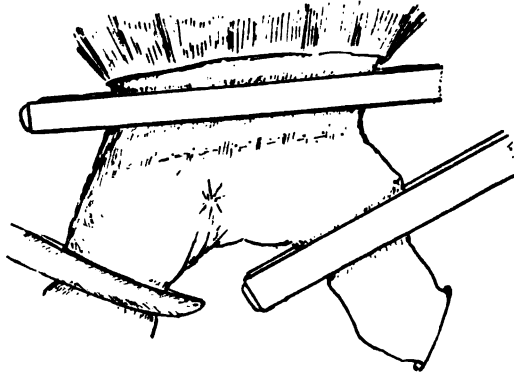


FIG. 74.—OPERATION FOR EXCISION OF THE PARTS IN A CASE OF JEJUNAL ULCER. Step 2.

The transverse mesocolon is detached from the stomach, so as to allow the stomach to be drawn well through the opening. A clamp is then applied in the same position which it occupied at the original operation. Clamps are applied to the jejunum on each side of the anastomosis. (Drawn by Mr. L. R. Braithwaite.)

CASE 3.—Jejunal ulcer following gastro-enterostomy. Excision. Roux's operation. Appendicectomy. Mrs. S. Sent by Dr. Bingham, Lancaster. Three years ago she had gastro-enterostomy done by a London surgeon for duodenal ulcer. For

some months she was better, then began to have pains in the body soon after food—almost immediately after swallowing it. She began to diet herself at once, and has done so ever since. Nineteen months ago she had a very severe hæmatemesis and nearly died, and twice since has had severe hæmatemesis. The pain, whenever she fails to take great care in her diet, comes on at a spot about one inch above the umbilicus, and may be very severe. She says it is like the pain she had before the operation. She has not lost weight, but has carefully dieted herself the whole



FIG. 75.—OPERATION FOR EXCISION OF THE PARTS IN A CASE OF JEJUNAL ULCER. Step 3.

The parts engaged in the anastomosis with the ulcer are removed. The distal end of the jejunum is closed. The proximal end is open and is ready for union with the jejunum lower down in an end-to-side anastomosis. (Drawn by Mr. L. R. Braithwaite.)

time. X-ray examination shewed all food going through anastomosis.

September 11, 1911. Old scar excised in right rectus. Gastro-enterostomy explored: it was posterior and nearly vertical. In the jejunum, one-half inch below the beginning of the anastomosis and near the mesenteric edge of it, was a small indurated stellate scar, which was about the size of a three-penny piece, and by its contraction caused marked narrowing of the jejunum. This was clearly the scar of a jejunal ulcer. Owing to the fact that a local incision would endanger the vascularity of the jejunum at this part, full excision was performed. The lesser sac was

opened around the anastomosis so that a part of the stomach was drawn through and a clamp put on above the anastomosis.

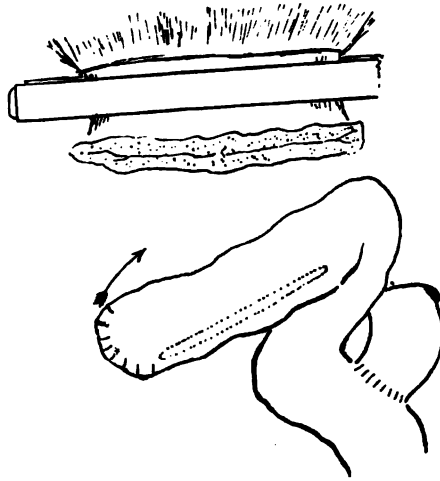


FIG. 76.—OPERATION FOR EXCISION OF THE PARTS IN A CASE OF JEJUNAL ULCER.
Step 4.

The jejunal end-to-side anastomosis completed. The upper closed jejunal end is now brought upward for a side-to-side union with the stomach. (Drawn by Mr. L. R. Braithwaite.)

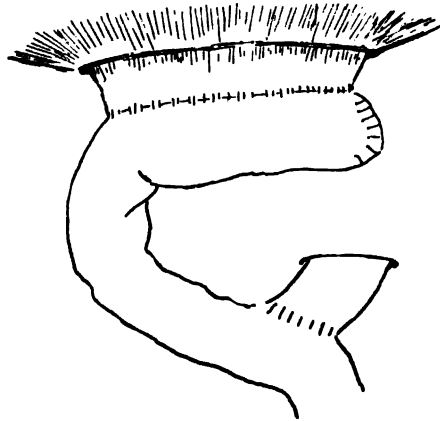


FIG. 77.—OPERATION FOR EXCISION OF THE PARTS IN A CASE OF JEJUNAL ULCER. Step 5.

The operation completed. (Drawn by Mr. L. R. Braithwaite.)

The jejunum distal to the anastomosis was clamped and divided and the distal end closed by suture. The jejunum proximal to

the anastomosis and to the ulcer was divided, and, owing to there being a longish loop, this was easier than usual, though even now there was difficulty. The proximal cut end was anastomosed at right angles to the distal jejunum, about six inches below its cut-and-closed end. The part of the jejunum left attached to the stomach (including the ulcer), together with the portion of the stomach projecting beyond the clamp, including therefore the gastro-enterostomy opening, was excised.

The length of jejunum formerly distal to the anastomosis, whose cut end had already been closed, was now clamped, and a side-to-side union effected between it and the opening in the stomach embraced by the clamp. The appendix was adherent and was removed. The original duodenal ulcer was well marked and was infolded and covered in by omentum.

CASE 4.—Transgastric excision of a gastrojejunal ulcer. The patient, a male, aged forty-seven, had a history of abdominal trouble extending over seven years. At the commencement his only symptom was epigastric pain on kneeling, on leaning forwards, in fact, after any movement which caused contraction of his recti abdominis. Gradually this pain became more severe, occurring at almost regular intervals, and accompanied by flatulence and hyperacidity. The pain was a typical hunger pain, commencing from two to three hours after meals, and was relieved by lying down or by taking food. There was never any vomiting. The epigastric pain was situated above and to the right of the umbilicus, and occurred only at intervals. Gradually, however, the intervals became shorter and the periods of pain longer.

After three and a half years of this he had a sudden attack of severe abdominal pain in the right hypochondrium, which was diagnosed as a subacute perforation; from this he recovered.

In January, 1912, a posterior gastro-enterostomy was performed by another surgeon. The patient recovered from this operation, and his symptoms subsided only to return about eight months later. The pain after this was lower in the abdomen and more to the left than previously—this pain was really the only symptom, but it was severe in character and for the last few weeks before I saw the patient almost constant in duration.

The x-ray report was as follows: "The bismuth food passes

freely through the œsophagus. The stomach is not dilated. The outline is regular except for an indentation about the middle of the greater curvature. Peristalsis is seen, but it is not excessive. The gastro-enterostomy opening is patent, and as far as I can judge about two-thirds of the food passes through it and about one-third through the pylorus. The stomach is empty two

Fig 78 -- Transgastric excision of jejunal ulcer.

hours after the meal. No food lodges in the duodenum, nor is there any duodenal kinking. The small intestine is empty in twelve hours. No stasis. No ileal kink.

"In twenty-four hours almost all the bismuth food has been passed per rectum. I have seen no abnormality in the large intestine.

"There is no x-ray evidence of calculus in either kidney, in the ureters, or in the bladder."

On January 7, 1914, I reopened the abdomen, excising the scar of the previous operation, and adopting for the deeper portions of the incision Crile's anæsthesia. On opening the abdomen the transverse colon presented: it was markedly hypertrophied and distended. It was kinked in a very curious fashion, its middle portion being adherent to the under surface of the left lobe of the liver and to the diaphragm. Before the stomach could be examined, it was necessary to separate the adhesions, fixing the colon in this unusual position. This separation was exceedingly difficult. The stomach itself was normal in outline, and there was a scar of an old ulcer on the first stage of the duodenum. The anastomosis which had been performed was a posterior vertical no-loop gastro-enterostomy. The stoma was of adequate size and in the correct position. On feeling the stoma with the finger a hard nodule, the size of a shilling, with a dimple in its centre, could be detected. This nodule, which was thought to be a gastrojejunal ulcer, could be clearly palpated through the anterior wall of the stomach. In view of the technical perfectness of the original operation, it was decided that a trans-gastric excision of the ulcer would be a safer operation than an excision of the entire anastomosis. Accordingly, while my assistant passed two fingers, one on either side of the jejunal loop so as to grip the ulcer, I made a longitudinal incision through the anterior wall of the stomach, parallel to the curvatures and midway between them. On opening the stomach my assistant everted the posterior wall through the opening, thus bringing the gastrojejunal ulcer into view. The ulcer was almost entirely gastric, being just on the edge of the stoma. On opening the stomach a piece of silk (or linen thread) was found hanging loose from the region of the ulcer.

Excision was performed with scissors, and the opening made in the posterior wall of the stomach closed with through-and-through sutures passed from the mucosa.

The anterior incision was then closed, leaving only room for a No. 14 rubber catheter, which was passed into the stomach and along the afferent jejunal loop.

After the closure of the anterior incision a few interrupted Lembert sutures were passed posteriorly in the region of the orig-

inal anastomosis. The abdomen was then closed, leaving the catheter *in situ*. The patient was given 4 ounces of peptonised milk through the gastrostomy tube on leaving the table.

The following case, in which there were two separate perforations of peptic ulcers in the jejunum, is recorded by Battle ("Lancet," vol. 1, 1905, p. 1246):—

The patient, a woman, aged 30, was admitted to St. Thomas's Hospital in March, 1903. The ulcer was situated in the anterior aspect of the stomach near the pylorus and was surrounded by a good deal of thickening. It was sutured, the peritoneum was cleansed, and a drainage tube was left in the lower wound. Anterior gastro-enterostomy was performed on April 9, 1904, for pyloric stenosis. On May 6, 1905, she underwent operation for perforation of a simple ulcer of the jejunum which had burst into the general peritoneal cavity. It was a circular clean-cut ulcer, situated about one and a half inches from the line of junction of the bowel with the stomach. The ulcer was sutured, the peritoneum was cleansed, and the two wounds through which this was done were closed without drainage. Finally, the patient was again admitted to the hospital on March 14, 1906, for symptoms of perforation. At the operation a perforated ulcer was found at the line of junction of the stomach and small intestine. The tissues around it were indurated. She left the hospital on April 12th, having made a very satisfactory recovery. It was of interest to note that there were no adhesions found at this operation; also that there was now no hernial protrusion of any of the scars.

7. The question of **chest complications**, parotitis, etc., is discussed elsewhere.

8. **Diarrhoea**.—An occasional sequel to the operation of gastro-enterostomy is the occurrence of diarrhoea. The attack may be slight, or may be so serious, so constant, uncontrollable and exhausting as to be the immediate cause of death.

It has been in my own experience extremely infrequent, and when noticed has been temporary and never alarming or serious. In only one case have special measures, dieting and the admin-

istration of opium, been necessary; the patient, a man of forty-six, was operated upon for duodenal ulceration, with recent excessive hæmorrhages. The diarrhoea lasted for five days, but, although troublesome, was never so unremitting as to give me any real anxiety as to the patient's ultimate recovery.

Much more serious experiences are recorded by others. Kelling ("Archiv f. Klin. Chir.," Bd. 62, 1900) and Anschütz ("Mitth. a. d. Grenzgebiet," Bd. 15, 1905, p. 305) have dealt with the subject in detail.

Kelling remarks that in the cases which prove fatal no obvious explanation of the diarrhoea, is discoverable. He suggests that there are two forms: *First*, that in which the diarrhoea is due to the escape into the intestine of acid contents not neutralised by the bile and the pancreatic juice. *Second*, that in which it is due to "fermentation." The latter is not serious, and is seen only or chiefly in patients suffering from carcinoma, or in those cases where there is an absence of free HCl.

The explanation of the first form lacks adequate confirmation. In spite of the fact that both bile and pancreatic juice may almost constantly be found in the stomach after gastro-enterostomy, acid contents may still escape into the intestine, and may indeed cause peptic ulcer. But it has not been suggested, or recognised, that diarrhoea occurs especially in those suffering from hyperchlorhydria, as one would expect if this hypothesis were accurate.

With regard to the explanation of the second form, this may be true in certain cases. Fermentation may go on to such a degree in the stomach that no amount of careful lavage will ensure the cleanliness of the mucosa. This may be proved by examining a pyloric growth after pylorotomy has been performed; the recesses of the irregular mass are sometimes extremely foul. The delivery of putrid, fermenting food into the jejunum would, of course, instantly set up diarrhoea. It is always remarked that the stools in such a case are "very offensive." But in not a few cases the diarrhoea does not appear at once, but only

after several days, when the patient has perhaps been doing well. It should also be remarked that cases have occurred after partial gastrectomy, when the infective area has been removed.

Anschütz believes the chief cause to be the excessive weakness of the patient, and remarks that the same type of diarrhoea is seen in those who suffer from advanced carcinoma elsewhere, or from extensive tuberculous disease apart from intestinal lesions. Carle and Fantino remark that the food runs through the intestine like water through a rubber tube, which is powerless to hasten or impede its progress.

It is apparent that no adequate explanation of this complication can be given; but it is probable that a strict attention to the diet, the administration of only sterile foods for some time after the operation, the giving of opium early, and the exhibition of drugs such as isoform, β -naphthol, salol, etc., whose purpose is to act as disinfectants, will comprise the most effective means at our disposal for preventing and for checking the onset of this symptom.

A. F. Hertz ("Annals of Surgery," October, 1913) mentions additional unfavourable complications after gastro-enterostomy, namely, too rapid drainage of the stomach, and, in cases of dilatation, situation of the stoma above the upper level of the gastric contents.

Where there is too rapid drainage of the stomach, the patient complains of a sensation of fulness, localised rather lower than the position where the pain of the original ulcer was felt; there is usually diarrhoea also, the bowels in some cases being opened after each meal. Hertz writes:

"In all patients suffering from this group of symptoms I have found with the x -rays that the stomach was small and hypertonic, and that the passage of food out of it was extremely rapid, so that a meal consisting of half a pint of porridge and milk, mixed with two ounces of bismuth oxychloride or barium sulphate, left the stomach in less than an hour, and in one case in less than ten minutes after being taken, instead of requiring the

normal three or four hours. If the patient is watched while he is taking the meal, the outflow from the stoma may indeed appear to be almost as rapid as the inflow from the œsophagus."

He adds that these appearances were seen both in cases where the pylorus was closed and where it was patent; indeed, in one case pyloroplasty had been performed. The feeling of distension is doubtless due to the rapid passage of the gastric contents through the stoma, leading to abnormal distension of the proximal portion of the jejunum. The diarrhœa is due to the irritation of the bowels by the food which escapes from the stomach too rapidly for efficient gastric digestion.

Treatment in cases such as this must be either palliative—*i.e.*, rest for an hour after food to delay the emptying of the stomach, combined with pancreatic extract to compensate for the deficiency of the normal secretion, and possibly small doses of belladonna to relieve the jejunal spasm set up by distension, or operative, *i.e.*, narrowing of the stoma. Another possible cause of trouble is situation of the stoma above the level of the gastric contents. In cases of gastric dilatation it often takes considerable time to ascertain which portion of the stomach will lie lowest when the upright posture is assumed. These cases usually improve with rest in bed, which allows the stomach to regain its tone, and also aids the emptying in cases where the stoma is not sufficiently low.

My own experience shews that the unsatisfactory results which follow upon gastro-enterostomy are due (apart from technical errors) almost exclusively to the performance of the operation in improper cases. If the operation is restricted to those cases in which definite organic disease is discovered in the stomach, distal to the suggested anastomosis, or in the duodenum, the results are uniformly satisfactory. Bad results are due to the adoption of the operation in cases where no lesion is present to justify it.

CHAPTER XIII.
OPERATIONS FOR CHRONIC GASTRIC ULCER.
GASTRODUODENOSTOMY.

THE operation of gastroduodenostomy was first suggested by Jaboulay in 1892, and performed by him in 1894. In 1895 Kummell independently suggested the same principle, the union of the duodenum to the stomach, but carried the principle out



Fig. 79. -Gastroduodenostomy: lines of incision (Jaboulay's method).

by dividing the duodenum completely across, closing the proximal end, and transplanting the distal end into the anterior wall of the stomach near the greater curvature.

Jaboulay united the anterior wall of the duodenum to the anterior wall of the stomach, folding the duodenum forward over a hinge, as it were, formed by the pylorus. Villard de-

scribed a modification of the method under the term "subpyloric gastroduodenostomy." Instead of folding the duodenum over on to the stomach, he anastomosed the contiguous surfaces of the stomach and duodenum.

The operation is most easily performed when there is a largely dilated stomach and a mobile duodenum. In one case reported

Fig. 80.—Gastroduodenostomy (Kümmell's method).

by Spencer any other gastro-intestinal anastomosis was impossible by reason of extensive adhesions which affected all of the pyloric portion of the stomach. When the pyloric region is adherent or invaded by growth, the operation is difficult or may be impossible.

The advantages of this procedure over gastrojejunostomy are claimed to be the easier emptying of the stomach at an ori-

fice near the natural outlet, and the absence of bile regurgitation, owing to the fact that the new opening in the intestine is placed above the bile papilla. The regurgitation of bile does, however, occur if a large opening be made.

The two methods of performing an anastomosis between the stomach and duodenum which enable the operation to be most satisfactorily completed are those described by Kocher

Fig. 81.—Gastroduodenostomy (Villard's method).

and Finney. Professor **Kocher** has suggested that the duodenum should be freed by stripping up the peritoneum to the right of the vertical (second) portion, so that an anastomosis between the stomach and the duodenum may be more readily performed. The following description is given by Professor Kocher ("Scott. Medical and Surgical Journal," October, 1903, p. 311):

"The most suitable incision is one similar to that which we recommend for exposing the gall-bladder, viz., an oblique incision two finger-breadths below and parallel to the right costal margin, beginning at the middle line. After dividing the skin and fascia, the rectus muscle is cut through as far as the broad abdominal muscles. The posterior layer of the rectal sheath, the fascia transversalis, and the peritoneum are divided. In muscular subjects the transversalis muscle is split parallel to its fibres, which are then firmly drawn apart. Should any adhesions exist between the gall-bladder and the colon, they must be divided. The liver is drawn upwards, the stomach to the left, and the transverse colon and the descending limb of the hepatic flexure downwards. The duodenum is then brought into view, and its outer border is clearly defined. A pad of gauze is placed against the under surface of the liver, and the latter is then drawn well upwards with a suitable retractor. Gauze compresses are also employed to push aside the stomach and colon.

"The delicate layer of parietal peritoneum covering the kidney is divided vertically $1\frac{1}{2}$ inches external to the second part of the duodenum, and the incision is then continued vertically downwards through the upper layer of the transverse mesocolon (which is held on the stretch) as far as the larger branches of the vessels. The fingers are then introduced behind the left edge of the incision through the peritoneum, and the duodenum is separated from the vertebral column, the vena cava, and the aorta until it can be brought forward and pressed against the pyloric portion of the stomach, which, in its turn, is compressed against the left edge of the wound in the abdominal wall, so as to shut off the general cavity of the stomach and prevent escape of its contents. Both stomach and duodenum are now compressed above and below between the fingers of an assistant, and the lateral anastomosis is effected in the usual manner by two rows of sutures.

"To one who has once convinced himself how easily and securely this lateral gastroduodenostomy can be performed—provided the duodenum can be rendered sufficiently movable—it will be evident how admirably the operation fulfils the indications for treatment in stenosis of the pylorus. Unlike the other surgeons who have performed gastroduodenostomy, we

do not limit the operation to special cases: on the contrary, we regard it as the normal procedure, and we are of the opinion that it will take precedence over all the previous methods of gastro-enterostomy and pyloroplasty.

"The method is subject to only one contraindication, viz., the presence of such extensive adhesions to the under surface of the liver that the duodenum cannot be sufficiently freed. This difficulty of adhesions can, however, often be overcome, as we have proved in three of our cases; but the fact of having to perform the suturing inside the abdomen is apt to interfere with the security of the stitching, especially in difficult cases. It is on this account that subpyloric gastroduodenostomy did not meet with universal acceptance. The subpyloric portion of the duodenum cannot be drawn out of the wound on account of its connexion with the gastrohepatic omentum and the important structures contained within it. This fixation to the under surface of the liver may be so firm that only the lower two-thirds, or only the lower part, of the vertical portion of the duodenum, together with the inferior flexure, can be brought in contact with the stomach.

"We therefore propose that, instead of Villard's subpyloric gastroduodenostomy, the name lateral gastroduodenostomy be given to this operation, to distinguish it from our method of inserting the divided duodenum into the posterior wall of the stomach after resection of the pylorus. The great difference between Villard's subpyloric gastroduodenostomy and our procedure is that we render the descending portion of the duodenum, the inferior flexure, and a considerable portion of the third (transverse) part so movable that the parts to be sutured can readily be raised up and surrounded with gauze, so that the sutures can be introduced extraperitoneally with comfort and security.

"We intend in future to perform lateral gastroduodenostomy in all cases of stricture of the pylorus, and only to have recourse to gastrojejunostomy in cases rendered unusually difficult by firm adhesions. We have performed the operation on five occasions—four times for cicatricial stenosis and once for malignant stricture. The results have been convincing: Regurgitation of bile either does not occur at all or only at first, when a large, gaping opening has been made. It is advisable to make the anastomotic opening as high as possible, and not

too large. The patient with carcinoma was at once relieved of all her discomfort. Only one patient complained subsequently of very severe pain, and he had a simultaneous cholecystotomy performed for gall-stones. That a dilated and sacculated stomach is not so well emptied as by our inferior gastrojejunostomy is obvious. If gastroduodenostomy be performed in such a case, it is advisable to occasionally wash out the stomach."

Finney's operation was described by its originator as "a new method of pyloroplasty." I am indebted to Dr. Finney for the following description of his operation, and for the privilege of being allowed to witness its performance by him at the Johns Hopkins Hospital.

The operation is as follows:

"Divide the adhesions binding the pylorus to the neighbouring structures; also free as thoroughly as possible the pyloric end of the stomach and first portion of the duodenum. Upon the thoroughness with which the pylorus, lower end of the stomach, and upper end of the duodenum are free depends, in large measure, the success of the operation and the ease and rapidity of its performance. I wish to emphasise this as one of the most important points in the operation. Frequently, at first sight, the pylorus may seem hopelessly bound down, when, after a little patient toil and judicious use of the scalpel and blunt dissector, it is found that it can be freed with comparative ease. A suture, to be used as a retractor, is taken in the upper wall of the pylorus, which is then retracted upwards. A second suture is then inserted into the anterior wall of the stomach, and a third into the anterior wall of the duodenum, at equidistant points—say about 12 cm.—from the suture just described in the pylorus. These second sutures mark the lower ends of the gastric and duodenal incisions respectively. They should be placed as low as possible in order that the new pylorus may be amply large. Traction is then made upwards on the pyloric suture, and downwards in the same plane, on the gastric and duodenal sutures. This keeps the stomach and duodenal walls taut, and allows the placing of the sutures with greater facility than if the walls remained lax. The peritoneal surfaces of the duodenum and stomach, along its greater curvature, are



Fig. 82.—Finney's operation. The duodenum and stomach are clamped. The line of incision is shown.

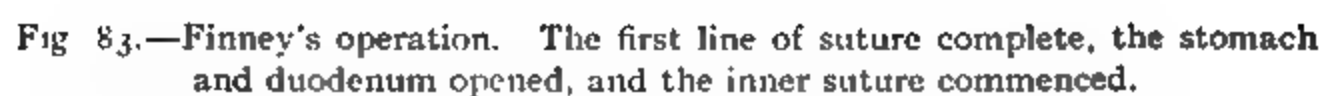


Fig. 83.—Finney's operation. The first line of suture complete, the stomach and duodenum opened, and the inner suture commenced.

Fig. 84.—Finney's operation. The inner suture nearly completed.

Fig. 85.—Finney's operation. The outer suture completed.

then sutured together, as far posteriorly as possible. For this row I would recommend the use of the continuous suture, as it is more easily and quickly applied, and it can be reinforced after the stomach and duodenum have been incised. After the posterior line of sutures has been placed, an anterior row of mattress sutures is taken, which are not tied, but left long, in the

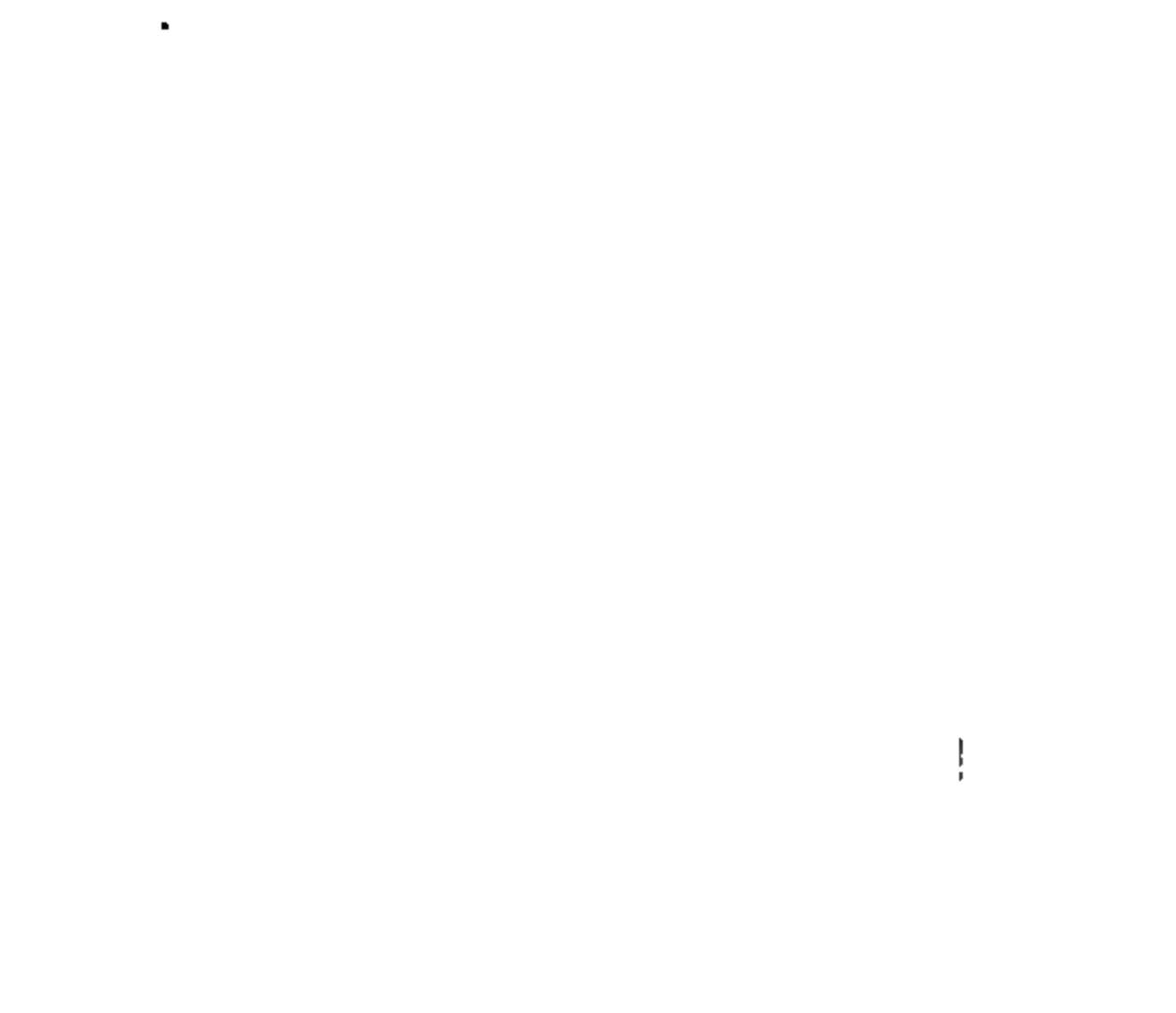


Fig. 86 —Finney's operation. A flap turned upwards to shew the alteration in the parts produced by the anastomosis (after Sinclair White).

manner indicated. These sutures, after they have been placed, are retracted vertically in either direction from the middle of the portion included in the row of sutures. Then, after all the stitches have been placed and retracted, the incision is made in the shape of a horseshoe. The sutures should be placed far enough apart to give ample room for the incision. The gastric arm of the incision is made through the stomach-wall just in-

side the lowest point of the line of sutures, and is carried up to and through the pylorus and around into the duodenum, down to the corresponding point on the duodenal side. Hæmorrhage is then stopped. It is well to excise as much as possible of the scar tissue upon either side of the incision in order to limit, as far as possible, the subsequent contraction of the cicatrix. This procedure I carried out in two of my cases with great satisfaction, and I should strongly recommend it in all cases where the walls of the pylorus are much thickened and there is much scar tissue present. It is well, too, to trim off with scissors redundant edges of mucous membrane, in order to prevent the formation of a valve-like fold of mucous membrane at the new pylorus. A continuous catgut suture is now taken through and through all the coats of the intestine on the posterior side of the incision. This reinforces the posterior line of sutures, secures better approximation of the cut edges of the mucous membrane, and prevents the reunion of the divided intestinal walls. The anterior sutures are then straightened out and tied, and the operation is complete, unless one wishes to reinforce the mattress sutures with a few Lembert stitches. This procedure, as is readily seen, gives the minimum of exposure of infected surface. All the stitches are placed and the posterior row tied before the bowel is opened, and it remains open just long enough to control the hæmorrhage. The size of the newly formed pyloric opening is limited in this operation only by the mobility of the stomach and duodenum and the judgment of the operator.

"In all of my cases the incision has been about 12 cm. in length, and could have been made longer had I chosen to make it so. Unless the stomach is very much dilated or has descended to an unusual extent, the lower limit of the new outlet is at or near the level of its most dependent portion."

I have, when performing Finney's operation, modified this method of performing it. I have, in fact, applied to the operation of gastroduodenostomy the method adopted in the operation of gastro-enterostomy; that is to say, I have applied clamps to the stomach and to the duodenum, and from both these viscera a large ellipse of the mucous membrane has been excised after division of the serous and subserous coats. The

Fig. 87. —Gastroduodenostomy; shewing the parts to be embraced by the clamp.

Fig. 88. —Gastroduodenostomy, the parts embraced by the clamps and the position of the anastomotic opening

clamps prevent hæmorrhage and the escape of fluids from the stomach and duodenum, and thereby make the operation speedier and simpler.

For this operation I have had made a special form of clamp, the blades of which at their origin are sharply bent at a right angle. The duodenum, even after being "mobilised," cannot always be brought easily to the surface; but with this clamp the bowel can be well secured, because the blade lies well within the abdomen, when the handle lies flat upon the surface.

The operation of pyloroplasty has fallen into almost complete disuse. Even in the hands of its warmest advocates it was an unsatisfactory operation, and the number of cases in which there was a recurrence of symptoms was very large.

The operation of Finney and the operation of Kocher have, however, a distinct place in surgery, and it is by no means unlikely that in the future they will be performed in a certain class of cases for which gastro-enterostomy is now the chosen method. It has seemed to me that in those cases where pyloric spasm is a prominent condition, where it is caused by ulceration in active progress at a point a little distant

from the pylorus, Finney's operation will be especially of service. In the ordinary case of pyloric stenosis, with dilatation and hypertrophy of the stomach, no operation could be more satisfactory than posterior gastro-enterostomy; for these cases it is hardly possible that it can ever be replaced by an opera-




Fig. 89.—Moynihan's clamp for use in Finney's operation and partial gastrectomy.

tion which is easier, speedier, or safer. In cases of active ulceration and pyloric spasm it is probable that Finney's operation will prove to be of great value.

In certain cases of hour-glass stomach a modification of Finney's operation may be used, as suggested by Kammerer.

GASTRO-ENTEROSTOMY COMBINED WITH JEJUNOSTOMY.

I have performed jejunostomy after the method of Witzel's gastrostomy in combination with the modified Roux operation in five instances, for cases of large chronic gastric ulcer surrounded by inflammatory tissue and adherent to the pancreas. Two of these have been reported for me by E. T. Tatlow ("Lancet," November 23, 1912):

"CASE 1.—The patient, a female, aged sixty had an anterior gastro-enterostomy in Y performed two years ago. At the operation a large circular ulcer was found on the posterior surface of the stomach near the greater curvature, adherent posteriorly to the pancreas. For some three months after operation the pain disappeared. The woman was readmitted to hospital in the middle of March, 1912, complaining of continuous epigastric pain, worse immediately after food. She lived on milk and 'slops,' vomited frequently, and starved herself for four or five days at a time; she was losing weight rapidly. At the operation in March the previous anterior anastomosis was found to be patent, whilst the ulcer was as large as at the original operation. Jejunostomy was performed, the jejunum being opened at a point about two inches above the fork of the Y anastomosis, in that portion of the bowel coming from the duodenojejunal flexure, the catheter being retained in position by the method described below. So far the results of this operation have been highly satisfactory. For six months the woman fed herself through her jejunal tube, she enjoyed complete freedom from pain, and has put on weight. For the past two months she has been gradually resuming feeding by the mouth.

"CASE 2.—The patient, a female, aged fifty-eight, had an anterior gastro-enterostomy in Y performed three years ago. At the operation a large gastric ulcer was found on the posterior

surface of the stomach, bound firmly down to the liver and pancreas. For twelve months after the operation her digestion improved, but later her symptoms returned. Twenty weeks before her readmission to hospital in Leeds, she was operated upon elsewhere for a subacute perforation. She came back to the Infirmary on September 16, 1912. Her gastric pain was almost constant and very severe in character, and she vomited almost daily. In this case also at the secondary (or, rather, the tertiary)

:

Fig 90. —Gastro-enterostomy combined with jejunostomy (author's method)

operation the anastomosis was found to be patent and a jejunostomy was performed."

The operation is carried out as follows:

The stomach is clamped as in the ordinary operation; a loop of 18 inches of jejunum is taken and an anterior vertical anastomosis performed. The proximal jejunal loop is divided near the anastomosis, and implanted into the portion of the jejunum,

leaving the anastomosis, the distal cut end near the anastomosis being first closed. The loop of jejunum coming from the duodeno-jejunal flexure to form one limb of the Y is now taken, and at a point two or three inches above the Y; on the side remote from the mesentery a small longitudinal incision is made into the lumen of the gut, and a No. 14 rubber catheter is introduced. This is fixed in position by a 000,000 catgut suture, taking all the coats of the bowel, the catheter having been passed down the jejunum 4 or 5 inches beyond the anastomosis. Then a series of interrupted Pagenstecher sutures are used, as in Witzel's gastrostomy, enclosing the catheter in a trough of jejunum, care being taken not to stenose the anastomosis. The line of suture is then fixed to the abdominal wall by a single stitch at each end, and the wound closed snugly round the catheter.

THE SURGICAL TREATMENT OF ULCERATION OF THE STOMACH DUE TO THE DRINKING OF CAUSTIC FLUIDS.

An examination of the museum specimens and a search into the records show that in cases in which an intensely irritating fluid has been swallowed, accidentally or with suicidal intent, the parts most affected are lips and mouth, the pharynx, and the first inch or more of the œsophagus, the lower end of the œsophagus immediately above the cardiac orifice, and the pylorus and pyloric antrum. The greater part of the œsophagus escapes serious damage, though patches of ulceration, or even gangrene, may be distributed throughout it. So far as the stomach is concerned, the worst injury is inflicted on the pylorus, but in severe cases the whole mucous membrane may be affected.

In several of the recorded cases appearances very closely similar to that which I have described were recognised. The contraction and consolidation of the pyloric portion of the stomach have been frequently observed. Mr. Keetley likens the appearance in one of his cases to "a small sausage"; of a second he says, "the pylorus was thickened and so contracted that it would only just admit the closed blades of a pair of polypus forceps"; and

a third that there was "thickening and a very tight stricture of the pylorus." In my own cases the pyloric antrum has presented the appearance of a normal uterus; the walls are thick and unyielding, the cavity small, and the pylorus projects downwards into the duodenum like the cervix into the vagina.

The mucous membrane is at once deeply burned; in the stomach it assumes very rapidly a deep purple or almost black colour, and ulceration speedily follows. In many of the specimens when a recent examination is made patches of gangrene with adherent food particles may be recognised. In addition to the cauterisation due to the irritating fluid a septic element caused by the decomposition of adherent food particles is present.

The symptoms noticed at the first moments are an intense burning of the labial and buccal mucous membranes, a scalding sensation in the throat, and an intense burning in the epigastrium. In many cases, though not in the one now recorded, vomiting occurs. The agony at the first may be almost unendurable, and shock is profound.

In the larger number of cases there is soon a marked difficulty in swallowing; when a few drops only of fluid are swallowed, the pain elicited may be excessive. Thirst is intolerable, the soreness of the lips and mouth when the sloughs begin to separate is terrible, and a raw bleeding surface may be left. Vomiting is an early and a constant symptom; even when a very small quantity of fluid is taken, it may be ejected at once or in a few minutes.

The character of the symptoms changes after a time, according as obstruction, due to the cicatricial contraction in healing, is caused in the oesophagus or in the stomach. When a stricture forms in the gullet, it is almost always at the upper end; when in the stomach, it is at the pylorus and in the pyloric antrum. In an apparently favourable case the local conditions quickly clear up, and fluid food may be taken in fair quantity and retained, but after the lapse of three or four weeks or more vomiting, which has been absent or in abeyance, returns more seriously than before. The stomach dilates, and its muscular walls hypertrophy until

the usual clinical picture of pyloric stenosis is produced in its most exemplary form.

In other cases the characteristic signs of obstruction in the œsophagus are produced, and in still others there may be obstruction both in the œsophagus, at the upper or lower end, and at the pylorus.

Treatment.—In all cases it is of the first importance to see that there is complete abstention from food of any kind. By

Fig. 91.—Gastrostomy combined with gastro-enterostomy.

giving food the process of ulceration is quickened, the ulceration spreads, gangrene in more or less extensive patches occurs, and a virulent septic process is set going. The chief attempt should be directed to keeping the scalded surfaces sweet and clean. Mouth-washes, sprays, gargles, frequent mopping of the ulcers with gauze swabs, all are useful in helping to ensure cleanliness. The administration of saline enemata by the rectum will help to relieve thirst to some extent.

It is probable that in all cases the safest course will be to have an early resort to surgery. By means of some operative procedure the feeding of the patient can be ensured for such a time as will allow healing to take place in the ulcerated patches.

The two operations—one of which will usually be needed—are gastrostomy, when the œsophagus alone is affected, and gastro-jejunostomy combined with gastrostomy, when the pyloric portion of the stomach is most injured. Duodenostomy, as practised by Hartmann, or jejunostomy alone, suffices merely to feed the patient for a time. They do nothing towards securing him against the almost certain troubles which will result from the mechanical obstruction at the pylorus due to the healing of the deeply ulcerated mucosa.

CHAPTER XIV.

EXCISION OF GASTRIC ULCER.

IN the early days of the surgical treatment of gastric disorders the surprising results obtained after gastro-enterostomy had been performed in cases of pyloric obstruction gave a very exalted reputation to this procedure. The drainage of the stomach, which in such cases was the chief necessity, was believed to be the need also in cases of ulcer found in parts of the organ distant from its outlet. Because the cases dealt with in the days of pioneer work embraced chiefly those in which a stenosis was present, and because a short-circuiting operation endowed the patients submitted to it with the most robust health, it was illogically assumed that gastro-enterostomy was the operation called for in all cases of gastric ulceration. A series of patients at the hands of many operators were accordingly treated by the operation of gastro-enterostomy when either no ulcer at all was discoverable in the stomach (a lesion probably existing elsewhere) or when a very little ulcer, seen or felt, lay at some point along the lesser curvature, perhaps nearer the cardia than the pylorus, or upon the anterior or posterior surface. The immediate results of the treatment of such chronic ulcers were often satisfactory, but a scrutiny of the after-results in my own cases demonstrated that in a large proportion the ultimate condition of the patient was far from good. I found that I was able to classify each case into three groups. In the first, a small group, embracing roughly 30 per cent. of the total number, the patients, after a period, generally of many months, regained their health and appetite, lost all the discomforts of dyspepsia, and with care were able to eat well and enjoy life. They were indeed fit to be pronounced "cured," though perhaps all did not display that sturdy and even reckless confidence in their capacities which the patient who has been re-

lieved of an obstructive lesion so constantly possesses. In the second group the patients soon began to make complaint of a return of their former gastric derangements, and in the end willingly submitted to a second operation, in which an excision of the ulcer or a pylorotomy had to be performed. In the third group, after a period of variable health, the symptoms returned as severely as ever, weight was lost, cachexia developed, and the patients died of carcinoma of the stomach. It might be urged of these that a mistake in the diagnosis had been made at the time of operation, and the possibility of such an error must be conceded: but in many, indeed in most, the time which had elapsed from the operation to the death of the patient, two and one-half, three, or even five years, made it seem more probable that the carcinoma had developed upon the base of an old ulcer. A comparison was made between the indubitable cases of gastric carcinoma treated by gastro-enterostomy and these cases; in the former group it was rare for a patient's life to be prolonged by a year and a half or more; in the latter life was advanced two and one-half years or more. Even allowing for the possibility of an occasional mistake, there could, we thought, be no doubt that in a large number of cases pathological processes, at first simple, had at last become malignant.

The question therefore arose as to whether the operation of gastro-jejunostomy should not be abandoned in all cases where the ulcer lay at a little distance from the pylorus, and be replaced by an excision of the ulcer with restitution of the integrity of the stomach where this was possible; or by the performance of Rodman's operation when the ulcer was contiguous to the pylorus, and when there was an inveterate and indurated ulcer likely to become malignant.

This then became our plan of procedure. If an ulcer lay in the pyloric region, either in the duodenum (far more frequently) or in the stomach (rarely), and was causing stenosis and was clearly not malignant, gastro-enterostomy was performed. If a

single ulcer lay in the body of the stomach and was not causing an hour-glass deformity, it was excised.

If an ulcer near the pylorus was very thick, much indurated, and possibly malignant, or if ulcers were multiple, Rodman's operation was considered to be necessary.

When the excision of the ulcer, say on the lesser curvature, two or three inches away from the pylorus, was performed, we found, at times, that an unsightly deformity of the stomach resulted, and in a few cases a second operation became necessary, either because the ulcer had recurred, or because the healing of the suture line and perhaps also its adhesion to parts adjacent, had caused a difficulty in the proper working of the stomach which only a short-circuiting operation could relieve. In such cases, therefore, we began to combine gastro-enterostomy with excision, the new anastomosis being made a little proximal to the new suture line. In three cases of my own ulcers on the lesser curvature, treated by excision, recurred, so far as we could judge, exactly in the suture line, and in two, perforation of the ulcers necessitated urgent secondary operations. Such recurrences may be due to the inadequate removal of the original ulcer. The induration and thickening around the crater of an ulcer extend sometimes very widely, and if the size of the crater is taken as the measure for the area to be excised, diseased tissue may be left behind. The hard fibrous edge of the wound so made may heal unkindly, and a new ulcer develop exactly in the line of suture. I have, therefore, made it a rule for the last few years to excise an ulcer very widely, cutting all round the crater, in tissues which are soft and healthy. So free a removal of the parts, however, has the disadvantage that a deformity of the stomach is far more likely to result when the suturing is completed. Since we have combined gastro-enterostomy with excision this has not, however, been a serious disadvantage, and it has had the supreme merit, so far, of preventing recurrences.

The experience which I have had with regard to ulcers of the body of the stomach, and the inefficacy of gastro-enterostomy in

curing them, is that which I believe has been the lot of most other surgeons. There are two notable exceptions. Kocher, to whose opinion the greatest weight always attaches, is satisfied that in his hands gastro-enterostomy will cure a gastric ulcer, wherever the ulcer may be.

H. Paterson ("Surgery of the Stomach," pp. 86-94) also considers that even if the ulcer lie near the cardia, or at any part of the body of the stomach, the anastomosis of the stomach with the jejunum will allow or even encourage the ulcer to heal. These writers believe in the "physiological effect" of a gastro-enterostomy as something different from its merely mechanical effect. Paterson asserts that the entry of the intestinal contents, bile, and pancreatic juice into the stomach, neutralising the acidity of the gastric juice, has a very decided effect in allowing an ulcer to heal.

The work of Barclay and others, who have examined the stomach by means of x -rays after bismuth meals had been administered, may throw some light on the discrepancies which exist between the surgeons upon this subject. Barclay has shewn ("The Stomach and Oesophagus," London, 1913) that in all cases of gastric ulcer a spasm of the stomach may appear, at times in the body of the organ at the area of ulceration, producing an hour-glass shape in the stomach, at times in the pyloric end only, but in both cases causing definite obstruction. It may be that the cases of gastric ulcer cured by gastro-enterostomy are made up largely or solely of those in which an obstructive spasm was present; the short-circuiting operation, acting then purely as a mechanical relief to the ulcer, by allowing food to escape from contact with it more quickly than in ordinary circumstances. My own experience, however, is very much opposed to the performance of gastro-enterostomy alone in any case of ulcer on a level with or proximal to the site of the anastomosis.

In connexion with the surgical treatment of ulcers of the stomach, the following general propositions may be affirmed:

1. In cases of obstruction at, or near, the pylorus the result

of the scar of former ulcers, the operation of gastro-enterostomy will afford complete and permanent relief.

2. Ulcers lying in parts of the stomach other than the pyloric antrum are best treated by excision. Gastro-enterostomy causes relief, or cure in some, but in others the result is bad or indifferent.

3. An ulcer lying upon the lesser curvature if of small size can be excised without the resulting scar causing any deformity of the stomach; if of large size excision should be combined with gastro-enterostomy. These cases are sometimes exceedingly difficult.

4. An ulcer lying upon the posterior surface of the stomach may be reached through the gastro-hepatic omentum, or through the transverse mesocolon, or by incision through the anterior wall of the stomach.

5. Large ulcers occupying a considerable extent of the lesser curvature, excavating perhaps the liver or the pancreas cannot be treated by excision as this would involve complete gastrectomy. I have found that gastro-enterostomy combined with jejunostomy gives the best results.

6. In cases of ulcer lying near the pylorus, where induration is considerable, the ulcer being of the "callous" variety, or when ulcers in the pyloric region are multiple, the excision of the "ulcer-bearing" area of the stomach—Rodman's operation—is the method of choice.

TECHNICAL CONSIDERATIONS.

1. If an ulcer of small size should be discovered in the body of the stomach on the anterior wall, and be free from marked induration or adhesion to other parts, it may easily be removed. Two incisions lying approximately parallel to the curvatures of the stomach should be made to surround the ulcer, and should fall entirely upon healthy parts; this is essential. The incision which remains after the ulcer is removed is then stitched up so that the line of suture runs from one curvature to the other; it lies, that is

to say at right angles to the lines along which the original incisions were made. In this way it will be made certain that no narrowing in the calibre of the stomach occurs when healing is complete. The sutures are placed in two layers, an inner of catgut and an outer of Pagenstecher thread. Generally it is better to make the catgut suture of the interrupted form. The outer thread is best introduced by Cushing's right-angled method; it is therefore continuous. The perfectly smooth appearance of the suture line, with no thread shewing, which results when this stitch is used is the surest method of preventing adhesion between the stomach and the abdominal wall.

2. If the ulcer should lie along the lesser curvature of the stomach, sending a branch down on to the anterior or the posterior surface or on to both surfaces of the stomach, resection may be difficult owing to the adhesion of the ulcer to the liver or the pancreas, or because of the remoteness of the ulcer from the abdominal incision. As a rule, however, the involved parts of the stomach can be drawn up into the wound without too great traction being employed, and without any addition being necessary to the original parietal incision. When the stomach has been coaxed up into the wound the abdominal cavity is securely packed off with hot moist swabs which are placed carefully in all directions. The lesser sac may be guarded by swabs introduced either through the gastro-hepatic omentum, or through an incision in the transverse mesocolon made after the colon has been raised. When all gauze packing is in place mackintosh sheets are put over them, and over the abdominal wall, so as to keep all parts not immediately engaged in the operation free from the risk of infection.

The purpose of the operation is to remove a wedge from each surface of the stomach, the base being at the lesser curvature, and the apex pointing towards the greater curvature. The operation may be begun by the ligature of the coronary artery at each end of the base of the wedge to be removed; but I have often found it possible to dissect off the artery from the lesser curvature,

lifting it away during the time the ulcer is resected, and replacing it at the end of the operation. When the vessel is secured in one or other of these ways a clamp is introduced between the ulcer and the cardia, and another between the pylorus and the ulcer, so that the whole territory to be dealt with is embraced by the clamps, which render the parts avascular and prevent soiling of the field by the escape of gastric contents. The ulcer is then ex-

Fig. 92.—Excision of an ulcer on or near the lesser curvature of the stomach. The clamps are applied to include the ulcer which is excised after separation of the gastro-hepatic omentum. In the small figure the first stitch is shewn.

cised, the incisions being carried well into sound tissues. The gaping of the wound is often very wide when this is done.

The appearance seen in the figure is then presented. There is a long wound through all the coats of the stomach beginning on the posterior surface, mounting over the lesser curvature and ending on the anterior surface. The closure of this wound begins on the lowest point of the posterior surface and continues

round to the lowest point on the anterior wall. The suture is a through-and-through suture of catgut, and it is of the Connell type. The needle passes on each side from serous to mucous and from mucous to serous surface, then crosses the gap, and passes again on the opposite cut margin from serous to mucous surface and back from mucous to serous. The diagram shews how this stitch is passed. On each side a "loop on the mucosa" is left.

Fig. 93.—The suture continued—note that the stitch is of the "loop on the mucosa" type.

By the time the lowest part of the anterior surface is reached a single Lembert stitch is taken to complete the line. The clamps are then removed, and sometimes a bleeding point or two may appear and require to be secured. An outer layer of suture is now necessary. The difficulty of its introduction may be considerable. The posterior surface of the stomach may be turned upwards through the gap in the lesser omentum, or it may be reached through the incision already made in the transverse mesocolon.

I have often borrowed a flap from the transverse mesocolon to place over the posterior suture line to prevent a new adhesion to the pancreas. The anterior line is then reinforced by a suture of the right angled Cushing type.

Instead of the Connell suture, which is of course continuous, interrupted through-and-through Lembert sutures or the Halsted suture may be used. I have tried them all and do not find any difference between them. The essential thing is, I believe, to prevent the suture line contracting adhesions, either to the pan-

Fig. 94.— The sutures completed.

creas behind or to the abdominal wall in front, for the fixity which thereby results is I feel sure a powerful factor for harm (see Coffey, "Surg., Gyn., and Obst.," 1910, ii, 545).

3. If the ulcer involves too large an extent of the surfaces of the stomach, as well as of the lesser curvature, or if a large ulcer be present on either anterior or posterior surface, then the whole segment of the stomach in which the ulcer lies may be excised. A cylindrical portion of the organ, that is to say, is removed together with the ulcer. This operation may be called

annular gastrectomy. The operation is performed in the following manner. The two curvatures of the stomach are freed from the omenta as widely as necessary, by ligature of the coronary and gastric epiploic vessels above and below. A cylinder of the stomach is in this way denuded of its blood-supply. At each end of this cylinder two pairs of clamps are placed and between each

Fig. 95.—Excision of an ulcer in the body of the stomach. The omenta have been ligatured. The dotted lines shew how section of the stomach is to be made.

pair the stomach is divided. The diseased ring of the stomach is then removed. The clamps which close the cut ends of the parts of the stomach which remain are brought together for anastomosis with one another. The surgeon must have foreseen the need for making these divided ends of approximately the same size. This

may easily be done by placing the distal clamp a little obliquely, so that a longer section of the stomach from curvature to curvature is made. There is usually no difficulty in bringing the cut ends of the stomach into easy apposition, for an ulcer which involves so large an extent of surface as to call for partial gastrec-

Fig. 96.—Excision of an ulcer in the body of the stomach. The outer suture completed in its first half; the inner suture being applied.

tomy has probably caused some obstruction and dilatation and a degree of hypertrophy in consequence.

When the clamps are placed side by side the anastomosis is carried out exactly as if gastro-enterostomy, or the ordinary gastro-anastomosis were to be made. Two continuous sutures are used; an outer serous, and an inner which secures all the coats, and so acts as an hæmostatic. The anterior half of the

outer suture is best introduced by the right-angled Cushing method, for the reason already given, that it leaves a smoother surface, one less likely to adhere to the parietal peritoneum.

4. If the ulcer lies on the posterior surface, perhaps adherent to the pancreas, it may be removed by one of three methods:

(a) By rotation of the stomach to a degree which allows the posterior surface together with the ulcer to be pushed forward

Fig. 97.—Transgastric resection of ulcer in posterior surface, showing line of incision surrounding the ulcer.

through an aperture in the gastro-hepatic omentum. A few stay-sutures passed into the stomach a little distance away from the ulcer will hold the parts well up to the parietal wound while excision is being made. This method is advocated by J. E. Summers ("Jour. Amer. Med. Assoc.," 1911, lvi, 1699) to whom we are indebted for many valuable technical suggestions in abdominal surgery.

(b) By approaching the stomach through the transverse mesocolon, as in the operation of posterior gastro-enterostomy. The hinder surface of the stomach is drawn well upwards and the ulcer, if small, is easily excised. A flap of the transverse mesocolon is then borrowed for application to the posterior wall of the stomach after the suture is completed.

Fig 98.—Transgastric resection of ulcer on posterior surface.

(c) By the transgastric method (see Chaput, "Bull. et Mem. Soc. de Chir.," 1894, p. 452; Brenner, "Wien klin. Woch.," 1896, p. 117; Pilcher, "Long Island. Med. Jour.," May, 1908, p. 187; W. J. Mayo, "Ann. Surgery," 1910, ii, 797, and Coffey, "Surg., Gyn. and Obst.," 1910, ii, 545). The ulcer is first freed from any adhesion it may have contracted to the pancreas. In doing this it is not infrequent to find that the stomach is opened at the base of the ulcer. A subacute perforation has occurred

long ago and the pancreas has actually formed a part of the base of the thick-walled ulcer. During the stage of separation, and afterwards, great care is taken to protect the lesser sac by packing gauze swabs through apertures made in the gastro-hepatic omentum, and in the transverse mesocolon. These gauze swabs generally suffice by their pressure to arrest any bleeding that may occur from the denuded surface of the pancreas. When the ulcer

Fig. 99.—Transgastric resection of ulcer on posterior surface.

is quite freed and the stomach can be brought well up into the wound an incision about 3 to 5 inches in length is made through the anterior wall of the stomach opposite to the ulcer; the incision runs parallel to the long axis of the stomach. A few vessels may bleed freely; they are seized with small clips, and the stomach-contents, if necessary, mopped away. The finger of the surgeon or an assistant passed up through the opening in the

transverse mesocolon presses forward the posterior wall of the stomach and cause it to protrude between the margins of the wound in the anterior surface. This movement is enough also to prevent any escape of the sparse contents that may be present in the stomach. Coffey advises the introduction, around the wound, of stay sutures, traction upon which will prevent the escape of fluids from the stomach. The ulcer is now surrounded by an incision, roughly elliptical in form, which cuts well into healthy tissue at every part.

Fig. 100.—Placing traction loops preparatory to opening the stomach for exploration (Coffey).

The wound in the posterior wall which now remains may be closed by a single layer of through-and-through sutures introduced from the mucous surface. It is necessary that the suture should be of thread since one has to rely upon a single layer. I have generally used an interrupted series of sutures placed closely together, but a continuous suture, which I have also used, is perhaps equally satisfactory. The sutures have to be discharged into the stomach and to escape; and it is perhaps easier for a short interrupted suture to do this than for a long continuous one.

Fig. 101.—The stomach has been incised, exposing the mucous surface. A callous ulcer is seen in the background, while the fluid contained in the stomach may be seen gravitating to the back. Dotted line indicates extent of incision by which this ulcer was removed from the posterior wall and the lesser curvature (Coffey).

Fig. 102.—First step in closing an incision in the stomach wall. Beginning knot of through-and-through right-angle suture is being tied from the inside (Coffey).

As a rule, complete confidence may be felt in the security of the suture line, but if a further auxiliary stitch is thought necessary, it may be that the hinder wall of the stomach can be brought out through the transverse mesocolon, as in von Hacker's operation, and an additional stitch or two introduced. If it is thought necessary, a small wick of dental rubber may be left in the lesser sac to act as a drain. I do not favour this, and have never employed any drainage in any of my cases. It is quite enough to ensure safety if scrupulous care is taken to avoid soiling of the

Fig. 103 —Continuing through-and-through right-angle suture and tying opposing loops over it (Coffey).

parts by escaping fluids. The use of the mackintosh sheets makes this a simple problem. If the suture line is well completed drainage is then quite unnecessary: if the suture line is not competent to hold, no drainage will save the patient. Indeed the use of even a thin soft rubber drain is probably harmful. I have used the transgastric method for the resection of a jejunal ulcer, in one case, with great satisfaction.

After all these forms of excision of gastric ulcer I am rather chary about giving food for three or four days. I do not encour-

age the patients to drink more than they need to slake their thirst. Continuous saline injections by the rectum will easily supply all fluids necessary for the first few days. Drinks are given chiefly for the gratification of the patients.

(*d*) In one case of large ulcer adherent to the pancreas Lynn Thomas pared the margins of the ulcer and dissected the mucous membrane up until he was able to bring the edges together over the base of the ulcer where they were sutured. The patient, a domestic servant in his own employment, remains well after several years. The same procedure has been adopted by Phillips of Bradford in two cases with excellent results.

CHAPTER XIV.

OPERATIONS FOR HOUR-GLASS STOMACH.

AN hour-glass stomach may be congenital or acquired. Congenital hour-glass stomach, the existence of which I have formerly disputed, is extremely rare. Only one undoubted case has been reported. Acquired hour-glass stomach may be due to the contraction of a chronic ulcer situated in the body of the organ, to cancer, to localised perforation of an ulcer in the body of the stomach followed by adhesion and anchoring of the stomach to the anterior abdominal wall or to the pancreas, and, finally, to perigastric adhesions which compress the stomach at or near its centre. In one remarkable case upon which I operated two constrictions were present, so that a trilobulated stomach was formed.

The stricture which divides the stomach into two portions may be placed at any point between the cardiac and pyloric orifices. As a rule, it is nearer to the pylorus than to the cardia, and as a result of the obstruction which it causes the cardiac pouch undergoes a marked dilatation. In the great majority of cases the greater curvature is pulled upwards to the lesser, but in two cases I have seen the normal outline of the greater curvature has been unaltered, the lesser curvature being tucked down towards it.

Hour-glass stomach is very much more common than was formerly believed. I have operated upon 54 well-marked examples. The condition, I believe, is occasionally overlooked, owing to an imperfect examination of the stomach. When, as not seldom happens, there is an obstruction at the pylorus as well as in the body of the stomach, the food, after passing from the cardiac into the pyloric pouch, again meets with an obstruction, and finds great difficulty in escaping through the narrowed

pylorus into the duodenum. The pyloric pouch then becomes gradually dilated and hypertrophied. It may, indeed, be so large that when the abdomen is opened it is mistaken for the whole stomach and a gastro-enterostomy is performed between it and the jejunum. Such an operation is, of course, doomed

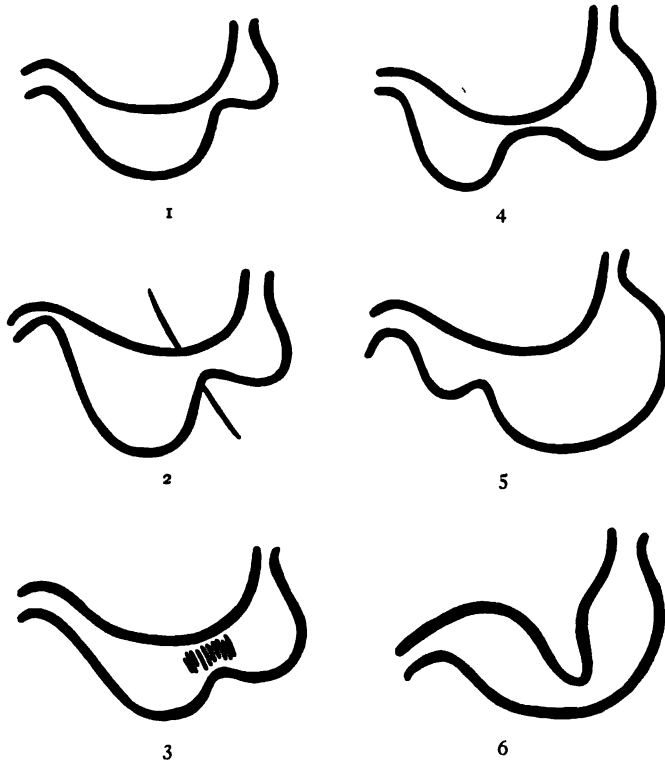


Fig. 104.—Types of hour-glass stomach: 1, Obstruction near cardiac end; 2, cardiac pouch concealed by adhesions; 3, growth in body of stomach; 4, two pouches connected by a narrow tube; 5, cardiac pouch largely dilated; 6, lesser curvature pulled down towards the greater.

to complete failure; for the symptoms are mainly due to the stenosis between the cardiac and the pyloric pouch, which is unrelieved. The most necessary precept to bear in mind in operating upon the stomach is that the *whole stomach*, from cardia to pylorus, should be seen and felt before any anastomosis is made. In at least three recorded cases a lack of ade-

quate and precise knowledge of the condition of the stomach has led to futile measures and fatal results.

In many cases of hour-glass stomach, as I have said, there is, in addition to the constriction in the middle of the organ, a narrowing due to old ulceration at the pylorus. It is because of this dual stenosis that the treatment by operation is often a matter of difficulty. In such circumstances no single operation will suffice to cure the patient; for if gastro-enterostomy is performed between the cardiac complement and the jejunum, food will escape through the isthmus into the pyloric pouch, and, there stagnating, will undergo decomposition and cause distension, flatulence, pain, and the occasional vomiting of putrid fluids. If the anastomosis is made between the pyloric pouch and the jejunum, the symptoms which the operation was destined to relieve will persist. In these cases, therefore, a double operation must be performed; a free passage must be made from the cardiac pouch to the pyloric, and thence to the jejunum. The following operations may be performed:

1. Gastro-enterostomy, single or double.
2. Gastroplasty.
3. Gastrogastrostomy or gastro-anastomosis.
4. Partial gastrectomy.
5. Dilatation of the constriction.

1. **Gastro-enterostomy** alone is suitable for a certain number of cases. When the constriction is within two or three inches of the pylorus, the pyloric pouch is small, not dilated, and, from the surgical point of view, is negligible. Nothing more is necessary to effect a cure than a free outlet from the cardiac pouch, and this is afforded by a gastro-enterostomy. The cardiac pouch is dealt with as though it were the whole stomach.

If both pouches require to be drained, a double gastro-enterostomy may be performed, as suggested by Weir and Foote. A long loop of the jejunum close to the flexure is isolated and is united to the two pouches by two separate anastomoses. Each pouch, therefore, drains into this loop. I

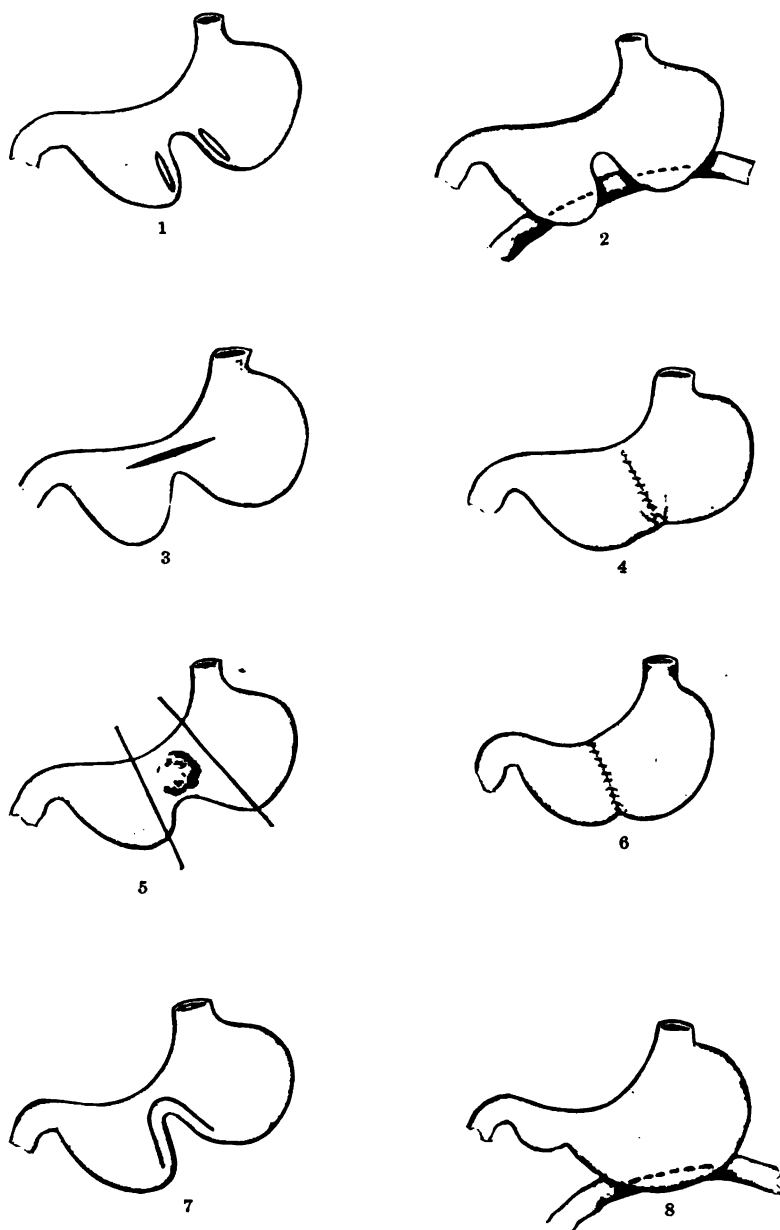


Fig. 105.—The operations for hour-glass stomach: 1, Gastrogastrostomy; 2, double gastro-enterostomy (Weir); 3, gastroplasty (the line of incision); 4, gastroplasty (the line of suture); 5 and 6, partial gastrectomy; 7, Kammerer's operation; 8, gastro-enterostomy.

have never given this operation a trial, but it is one which would probably prove successful.

2. **Gastroplasty** is an operation the rôle of which is very limited. It is applicable only to those cases in which a narrow stricture is present in the absence of induration, active ulceration, or external adhesion. In many of the recorded cases it is noted that there was "recovery without relief." It is probable that, as with pyloroplasty, the operation will be abandoned in favour of worthier methods. The cases to which it is suited are few, and more successful operations can be practised even in them. The operation consists in making a long transverse incision or slightly curved incision through the stricture, and continuing the incision well onwards into the healthy stomach-wall of both pouches. The incision should be at least 4 inches in length. The transverse incision is now made into a vertical one by applying a pair of clips at the middle of the upper and lower edges, and drawing them as far apart as possible. The wound is then sutured. It is the operation of pyloroplasty applied to the body of the stomach.

Dr. Kammerer, of New York, has adopted a modification of gastroplasty that will relieve the operation of many of its objections. His method bears the same relation to gastroplasty as Finney's operation does to pyloroplasty. His description is as follows: "Beginning at the lowest point of the constriction, a running suture was applied through the serous and muscular coats, bringing the vertical edges of both compartments of the stomach into close approximation along their posterior margins. An inverted V-shaped incision was now made through the suture thickness of the stomach-wall, about $\frac{1}{4}$ inch to either side of the Lembert suture. The posterior wound edges were now brought together with another running suture from within, the same procedure being then applied to the anterior edges from without. The final act of the operation consisted in reinforcing the anterior suture with a running Lembert stitch, and placing a few extra sutures at the lowest point of the stomach

through the serous and muscular coats, where tension would naturally be greatest." The patient made an excellent recovery.

3. **Gastrogastrostomy or Gastro-anastomosis.**—This operation was first performed by Wölfler in 1894. He made vertical incisions 7 cm. in length into the dependent pouches on each side of the central constriction, and united these so as to form a free passage beneath the isthmus.

The stomach is clamped on each side of the isthmus, and the clamps are surrounded with hot machintoshes. A suture is

Fig. 106.—Hour-glass stomach. The dotted lines indicate the position of the openings in the operation of gastrogastrostomy.

then passed through the serous and muscular coats of the part of the stomach, on each side, below the isthmus, reaching from it to the greater curvature. The needle is then temporarily laid aside. The incisions are then made in front of the suture line, through all the coats to the mucosa, a large ellipse of which is excised. A continuous suture, picking up all the coats, is then passed along the cut margins posterior and then anterior until the opening is completely encircled. The original needle which had been laid aside is again picked up, and an anterior

line of sutures is completed. The operation, in fact, is precisely the same as the operation of gastro-enterostomy, save that the stomach is embraced by both clamps instead of by one only.

Sedgwick Watson in 1895 successfully performed gastrogastrostomy in a different manner. The incisions in the two segments of the stomach were transverse. The pyloric portion of the viscus was folded over the cardiac, with the isthmus

Fig. 107.—Hour-glass stomach. The application of clamps and the method of suture in gastrogastrostomy. The details are the same as in the operation of gastro-enterostomy.

as a hinge, and the two stitched together with an elliptical line of sutures before being opened. The anastomosis was then made by incising the wall of the compartment which now lay anterior, and through the opposite side making an opening into the cardiac pouch in the centre of the elliptical area which had been surrounded by the suture. This method has never been repeated, so far as I know.

4. **Partial gastrectomy** will more often be practised in cases of cancer than in cases of simple disease. In cancer a wide excision is necessary, upon the lines laid down in the chapter dealing with operations for malignant disease of the stomach. When the mass of ulcer or growth has been removed, an end-to-end approximation of the stomach can be made, or both cut ends may be closed and an anastomosis made between the cardiac pouch and the jejunum.

Fig. 108.—Partial gastrectomy for hour-glass stomach (Coffey).

5. **Digital Divulsion or Dilatation.**—Operations of all kinds upon hour-glass stomachs may be made difficult by the adhesion of the ulcer whose contraction is responsible for the deformity. Adhesion to the anterior abdominal wall, to the liver, or posteriorly to the pancreas may be so strong that the operative manipulations are greatly embarrassed. A separation of the stomach from the anterior abdominal wall is always possible, though, as in cases of my own, a portion of the abdominal wall has to be removed, or the stomach laid open in so doing.

When the stomach is adherent posteriorly, or when, owing

to the infinite complexity of adhesions, the cardiac pouch cannot be reached, the constriction between the two pouches may be dilated by the fingers until a free communication exists below the cardiac and pyloric segments. In one case I was unable to do more than this. The mass in the stomach I took to be, with the experience I then possessed, malignant and irremovable. The cardiac pouch, owing to adhesions, was beyond the possibility of inspection or manipulation, and I was, therefore, compelled

Fig. 109.—Partial gastrectomy for hour-glass stomach (Coffey).

to be content with a retrograde dilatation of a very narrow constriction. To my surprise the patient made a perfectly uneventful recovery; she rapidly gained over three stones in weight, and to this day remains well, all trace of a tumour having disappeared.

A full account of the subject of hour-glass stomach with a record of my cases will be found in the "British Medical Journal," February 20, 1904, p. 413. I have now operated on 54 cases.

CHAPTER XV

THE OPERATIVE TREATMENT OF CANCER OF THE STOMACH.

THE surgical treatment of cancer of the stomach still leaves much to be desired. The medical treatment is now, as it always has been, absolutely hopeless, and still involves a mortality of 100 per cent. The crying need in cases of carcinoma not only of the stomach, but of all other parts of the alimentary canal, is for earlier diagnosis, and the chance of earlier surgical treatment. Amongst the notable achievements of surgery in recent years, chiefly as a result of the work in the Mayo Clinic, is the proof that in a large proportion of cases the onset of cancer in the stomach is not a new and unaccountable thing, but is, on the contrary, a tardy development upon an earlier condition which for years has clamoured for recognition.

I am, of course, well aware that all cases of cancer of the stomach, unhappily, do not come to the surgeon. No one but the surgeon can do any good to patients so afflicted. Yet there is a strange timidity of approach to the surgeon which is unaccountable, and far too often the favourable period in the history of a case is allowed to slip away before any recognition of the real conditions is attempted. It is true, then, and must be admitted, that when the surgeon speaks of the work which passes under his hand he is not speaking of the whole. Nor is any one else. Neither the physician nor the post-mortem investigator knows the whole range of cases; indeed, each sees far less nowadays than the surgeon. The view of the latter, therefore, if not all-embracing, is doubtless wider than that of any one else. The experience of the surgeon shows—and here geographical considerations seem to matter little—that roughly two out of three of all patients who come for relief from a condition of carcinoma of the

stomach give a history of inveterate and recurring dyspepsia over a stretch of many months or years. No one knows so well as the surgeon, for he made and repeats daily the discoveries, that such a history does not always mean that there is a chronic ulcer of the stomach, healing and breaking down afresh, during all that time. But though we are grown chary of making a diagnosis of "gastric ulcer" with that ease and certitude which formerly attached to the physicians of all countries, we can and do make an accurate diagnosis in a large proportion of the cases, if only those patients are allowed to be suffering from "gastric ulcer" who can hardly be supposed to be the victims of any other organic lesion.

The surgeon who walks by sight and not by faith knows that a gastric ulcer is a real thing, though so many impostors have claimed his attention. In the majority of the cases of gastric carcinoma the history given of earlier attacks makes it almost certain that these were due to a veritable ulcer of the stomach. There may be, I fully admit, errors in this estimate; but making all the allowances that our operative experience warns us to be necessary, there can be, I think, no doubt at all that a genuine chronic gastric ulcer has been the cause of that dyspepsia of which recurring attacks are noted. In one of these attacks, perhaps after an interval of months or years of freedom, something different is noticed. The attack is heralded in the old way; at first no difference between it and the others may be observed. But by degrees it is realised that something worse is occurring. The symptoms, which in earlier attacks were so easily amenable to careful treatment, to rest, to sparing diet, and so forth, have now become more severe and incoercible. Relief does not come from the measures which before have been so instantly successful. Moreover, weight is more rapidly lost, anæmia may develop, and anorexia is most persistent and distressing. This is the occasion, all other and more favourable occasions having lapsed, when instant—it can hardly be called precocious—surgical treatment should be urged. The patient has now arrived at middle life, or has passed it, and the diagnosis of cancer may tentatively be made and should

be acted upon with alacrity. Surgical intervention for purposes of inquiry has hardly any mortality nowadays. If a cancer be found and a resection of the stomach is undertaken, the mortality will vary with the expertness of the hands which practise it. But whatever that mortality may be, it cannot attain the death-rate of inaction and of "expectant" or medical treatment, which is exactly 100 per cent.

It was urged by Dr. W. L. Rodman many years ago that resection of the pyloric end of the stomach for the ulcers that singly or in clusters are found there was the most prudent mode of treatment. In his clinic at Rochester Dr. W. J. Mayo has for several years resected the stomach not only for chronic ulcers in the vicinity of the pylorus, but also for those tumours which might be due to ulcer or might be due to cancer, for declared cancer and for those cancers which, though evidently not curable because of the enlargement of distal, secondary glands, or other visceral deposits, were yet removable. In his so safe hands resection has hardly any greater mortality than gastro-enterostomy. This procedure is questionless the ideal one. It has afforded, of course, a unique series of specimens for investigation. Drs. Wilson and MacCarty conclude from their examination of all the material so furnished that in 71 per cent. of these cases of cancer of the stomach the malignant process is engrafted upon a simple one, that cancer is really due to a secondary change which starts in the edge of an ulcer of long standing. My own material, far less in quantity, bears out their contention. It has been shewn that in the base of these ulcers tending to cancer the mucosa has gone, leaving only scar tissue; in the overhanging border of the ulcers the mucosa is proliferating and some epithelial cells, nipped off by scar tissue, are shewing all the stages of aberrant proliferation with infiltration of the surrounding tissues and metastases in the lymphatic vessels of the stomach wall. The truth of these observations is hardly yet admitted by those whose inquiry has been based only upon specimens found in the post-mortem room or on the shelves of the museums—upon parts, that is, that have

been long dead, and subjected, no doubt, to the many changes which death and swift decay bring in every cell. There is need to develop a science of "histology of the living" to supplement and explain the "pathology of the living." Upon the post-mortem table only the final dilapidated ruin of the disease is seen; in specimens removed during life the disease in its earlier stages can be scrutinised. The material upon which the pathologist has formerly worked has not been favourable to the discovery of the truth; the sources of eternal truth were poisoned.

A review of the cases which have been under my own care has convinced me that though the history, especially in so far as it tells of former attacks of chronic gastric ulcer, may awaken a keen suspicion as to the presence of a carcinoma in the stomach, and though all the ancillary evidence to be derived from the chemical examination of the stomach contents may go towards a confirmation of the diagnosis, there is only one means of making an assured diagnosis in an early stage. An inspection of the parts, and this alone, and that indeed not always, can give us the information upon which a probable diagnosis can be made. It is necessary for us to realise that by any other methods than this one a positive diagnosis of cancer in the stage when it is capable of successful treatment is almost impossible. If the patients who are suffering from this most insidious and most terrible disease are to have any fuller prospect of relief, or of cure, the use of the exploratory operation must be greatly increased. I deprecate more strongly, I believe, than most surgeons the adoption of the "exploratory incision"; but every argument and all experience shew that in cases of carcinoma of the stomach no other method than this offers any slenderest hope for the betterment of the present deplorable condition of affairs. But before we are entitled to advise any patient to undergo this operation we must be confident that there is a well-grounded suspicion that some condition not admitting of remedy by any other than surgical means will be found.

Indications for Operation in Chronic Gastric Diseases.—I think

that an operation should be advised in the following circumstances:

(a) In all cases of chronic gastric ulcer. The recent experience of surgeons has shewn that a diagnosis of chronic gastric ulcer can be made with fair accuracy, and that not only the presence but also the position of the ulcer can be sometimes predicted. When repeated "attacks" occur it is idle to consider any other than operative treatment, for nothing else can give permanent relief. If any attack occurs in a patient over forty years of age the need for surgical intervention becomes urgent.

(b) When gastric stasis is present. This is a condition the existence of which is easily determined. If there are symptoms suggesting structural disease in a stomach incapable of emptying itself completely in from ten to twelve hours, then the conditions which exist are mechanical, and can be remedied by none other than mechanical means.

(c) When a tumour is present. The tumour may be simple or malignant, but research is better conducted by inspection than by any other means at our disposal.

In these three conditions medical treatment may do something to relieve, it can do nothing to cure. There is accordingly no reason for delay in advocating operation. If this is done, and done early, many cases of carcinoma that now drift quietly into the inoperable stage may be saved.

The position seems now to be this—that there are no signs or symptoms clearly indicative of the presence of gastric cancer; there is no refinement of clinical inquiry nor any endowment of clinical acumen which will enable a confident diagnosis to be made in an early stage; inspection of the stomach during an operation carried out when definite faults in its working are known will permit of the early discovery, or of the prevention of a certain proportion of the cases of cancer. The surgeon must not ask the physician for a sign which will reveal the presence of this disease to him, but he can and should require that those conditions which are only to be remedied by operative measures should

be referred to him not in their advanced or terminal stages, but at the earliest moment of their recognition. The success which has followed the surgical treatment of gastric disorders justifies this simple request.

THE LYMPHATIC SYSTEM OF THE STOMACH.

As I have already pointed out, an accurate knowledge of the lymphatic system of the stomach, as of other organs, is essential if the operative treatment of malignant disease therein occurring is to be attended with any degree of success.

The lymph-vascular and lymph-glandular arrangements in and around the stomach have been very carefully studied in recent years by many observers. Among these Most ("Archiv. f. klin. Chir.," 1899, lix, 175), Cunéo ("De l'envahissement du Systeme lymphatique dans le Cancer de l'estomac," Thésis, Paris, 1900; and again in "Travaux de Chir. Anat.-Clinique," par H. Hartmann, 1903, page 244), Borrmann (Das Wachstum und die Verbreitungswege des Magencarcinoms," Jena, 1901), Lengemann ("Verhandl. d. Deut. Gesellsch. f. Chir.," 1902, 483), Polya and v. Navratil ("Deut. Zeit. f. Chir.," 1903, lxi, 437), Jamieson and Dobson ("Lancet," 1907, i, 1061) have done work of the highest value. The investigations of Most, Borrmann, and Lengemann were inspired by Mikulicz, to whom is due the credit of first demonstrating the principles, and indicating the methods upon which the rational operative treatment of cancer of the stomach must be based.

The greater part of the work of investigation has been carried out upon the bodies of foetuses or infants, and the lymphatic injections have been made after the method of Gerota. It is stated by Polya and von Navratil that the number of the glands increases considerably in adult life, either by the division of the original glands or by their fresh development from lymph-vessels. Though the results obtained by these investigations, especially those of Cunéo and Polya and von Navratil, are of the highest value, they are not to be accepted without discrimination as in-

dicating the lines of surgical procedure. For we have as yet little or no knowledge of the changes which the lymphatic system undergoes between foetal life or early infancy and the period of life at which cancer is found. In this period changes in the number of the lymphatic glands undoubtedly occur, and it is possible that vessels, which in the foetus run to distant glands, are intercepted by newly developed glands in the adult. Of the changes in the vessels little is known, but there is evidence to shew that in the aged they are withered and shrunk or obliterated in some degree, so that they are no longer easy channels for the conveyance of cancer cells. It must also be remembered that when cancer develops in any part, say in the pylorus, the cancer cells are carried in the lymph-stream in the direction which is usually followed. This direction is indicated in the specimens in which the injection method of Gerota has been performed. But in cases of cancer the early involvement of certain lymph-vessels, their plugging by cancer cells, or the implication of a single gland, may be enough to disturb the normal direction of the lymph current. In such circumstances an erratic course may be pursued by the cancer cells carried away from the growth.

The stomach-wall is freely supplied with vessels, which commencing blindly beneath the surface epithelium, surround the glands, forming periglandular and subglandular plexuses. From the latter, large vessels arise, which, passing through the muscularis mucosæ, enter into the large submucous plexus. From this again wide vessels pass outwards to the subserous network, which lies immediately beneath the peritoneal covering. In these vessels there are innumerable valves which give to the injected trunks a beaded appearance; in the lymph plexuses within the walls of the stomach are no valves. When an injection of the submucous or subserous plexuses is made the fluid, though it is distributed widely, yet shews a definite inclination to pass in certain directions. Certain territories are therefore mapped out in the stomach, a little arbitrarily perhaps, but nevertheless with useful purpose, to indicate the normal lymphatic watersheds.

Cunéo describes three such areas. One lies along a line drawn from the apex of the fundus (approximately) to the middle of the pylorus in such manner as to separate the upper two-thirds of the stomach from the lower third; the lymphatics of this area drain upwards to the lesser curvature and the cardia. The part of the stomach lying below this line is divided into two at the mid-point of the greater curvature, a point which lies vertically below the right margin of the œsophagus as it enters the stomach, and which indicates the separation between the areas of the stomach supplied respectively by the right and left gastro-epiploic arteries. The lymph-vessels in this lower part of the stomach drain towards the greater curvature, those on the right obliquely towards the pylorus, those on the left towards the spleen.

The vessels all drain into lymphatic glands, which are placed in certain groups. A description of these may be given before the connexion between the vessels and the glands is described.

The lymphatic glands connected with the stomach follow closely the distribution of the arteries to the stomach. The names given to the glands are therefore most conveniently those which the arteries bear. It would be unnecessary to refer to this were it not that there has been, as there too often is in matters anatomical, a great confusion of names and a needless multiplication of them. The following gland groups will be described:

I. The Glands Associated with the Coronary Artery.—The glands in connexion with the coronary artery are divisible into certain groups.

- (a) Lower coronary.
- (b) Upper coronary.
- (c) Paracardial glands.

(a) *Lower Coronary Glands.*—These glands lie along the left half of the lesser curvature, in association with the descending branch of the coronary artery, between the layers of the gastro-hepatic omentum. Their position is apt to vary; they are usually close to the artery, but may, according to Letulle, be

PLATE I

The arteries and lymphatics of the stomach. Anterior view. Diagrammatic
and based upon the authors mentioned in the text

PLATE II

The arteries and lymphatics of the stomach. Posterior view.

embedded in the wall of the stomach, or they may slip downwards on the posterior surface of the organ. They are few in number in the foetus, and, as a rule, are found only on the cardiac half of the lesser curvature; they are larger and more numerous towards the cardia, and extend up to the right paracardial glands. They receive their afferent vessels from the whole length of the lesser curvature. The vessels from the pylorus run very obliquely in the wall of the stomach before reaching the glands, those from the middle of the stomach less obliquely, the vessels all radiating, fanwise, to the gland group. The number of these glands is very variable. Polya and von Navratil found, as a rule, only two or three; Lengemann, in one specimen, discovered 14. Their efferents discharge into the upper coronary group.

(b) *Upper Coronary Glands*.—This group lies along the main trunk of the coronary artery as it is embraced by the peritoneal fold known as the *falx coronaria*. They are the most constant and the most important glands of this region, and are found on all sides of the arterial trunk. Below, the chain is continuous with the lower coronary group, and above with the glands around the *cœliac axis*, at the upper border of the pancreas. Their afferent lymph-vessels come from the lower coronary group, and from the next two groups to be described; in addition they receive lymph-vessels, as Polya and von Navratil pointed out, direct from the lesser curvature of the stomach. (This observation, which is confirmed by Jamieson and Dobson, is one of great significance from the surgical point of view.)

(c) *The paracardial glands*, with their lymphatics form, as Most appropriately says, a "girdle" round the cardia of the stomach. They are divided by some authors into two or three groups, according as they lie behind, to the left or right of the cardia. The right paracardial glands are constant; they receive, according to Polya and von Navratil, their afferents direct from the lesser curvature of the stomach, and from the retro-paracardial glands and the left paracardials. Their efferents discharge into the upper coronary glands. The left paracardials:

Their efferents discharge into the upper coronary glands. The left paracardial glands, according to Cunéo, are often wanting, but Polya and von Navratil found them constantly and Jamieson and Dobson confirm this. Both these observers found them occasionally in large numbers (six and seven). Their efferents come from the fundus, in front and behind, and discharge into the right paracardial or upper coronary groups. Behind, a retrocardial gland may intercept a few vessels.

II. The Glands Associated with the Hepatic Artery.—It is more especially in connexion with these glands that a needless confusion in the nomenclature has crept in. The glands may be divided into separate groups:

- | | | |
|-------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(a) Glands in connexion with the right gastroduodenal artery.</p> | <p>{</p> | <p><i>A lower group</i> lying along the right gastro-epiploic artery below the greater curvature of the stomach.</p> <p><i>An upper group</i> lying near the bifurcation of the gastroduodenal artery.</p> <p>(The name "subpyloric" is given to the two divisions by Polya and von Navratil, but only to the upper group by Jamieson and Dobson).</p> <p><i>A retropyloric group</i> lying by the side of the gastroduodenal artery behind the pylorus.</p> |
| <p>(b) Glands in connexion with the trunk of the hepatic artery, right supra pancreatic glands.</p> | | |
| <p>(c) An occasional gland lying beside the pyloric artery, the pyloric artery, the suprapyloric gland.</p> | | |

(a) *Glands in Connexion with the Right Gastro-epiploic Artery.*—These glands are usually described as lying in two groups, a lower and an upper, between which is a distinct interval.

The lower group, usually two to seven in number, lies along the right gastro-epiploic artery, below the greater curvature of the stomach, between the layers of the great omentum. The glands are not found to the left of the midpoint of the greater curvature; they lie usually on the lower side of the artery they

accompany, and they are apt to stray downwards in the great omentum. Their afferent vessels come from the lower third of the stomach along the right half of the greater curvature. Their efferents, without exception, discharge into the glands of the upper group.

The upper group, consisting of four, five, or more glands, lies beyond the pylorus, in the angle formed by the first and second parts of the duodenum, at or near the point of bifurcation of the gastroduodenal artery. They receive afferent vessels from the pylorus, and from the duodenum and the efferent vessels from the lower group. The course taken by their efferent vessels is in three directions:

- (a) To the chain along the hepatic artery, the retropyloric glands being sometimes interposed.
- (b) Across the pancreas, or through the gland, obliquely to the glands around the celiac axis.
- (c) To glands lying in the root of the mesentery; this is the direction taken by the majority of the efferents.

The retropyloric glands, few in number and inconstant, lie behind the pylorus, on the front of the pancreas, by the side of the gastroduodenal artery. They receive afferents from the group just described, and also direct from the hinder surface of the pylorus and duodenum. These glands are described by Most and Cunéo and are figured by Cunéo and Lengemann. They were not seen by Jamieson and Dobson; but of their occasional existence there can be no doubt. It may be that they are only aberrant members of the gastro-epiploic glands, or more probably prolapsed members of the group of glands along the hepatic artery.

(b) *The Glands in Connexion with the Main Trunk of the Hepatic Artery. Right Suprapancreatic Glands.*—These glands are few in number and lie beside the trunk of the hepatic artery, along the upper border of the pancreas. They receive afferent vessels, as Most and Polya and von Navratil have shewn, directly from the upper border of the pylorus, a "suprapyloric"

gland being occasionally placed in the path of one or more vessels, and also efferents from the upper gastro-epiploic group. (The glands are, therefore, both primary and secondary.) Their efferents go to the glands around the coeliac axis.

(c) Occasionally a gland is placed along the pyloric artery to the right of the lesser curvature. It intercepts a vessel from the pylorus, and transmits its efferents to the right suprapancreatic group.

III. The glands along the splenic artery are surgically the

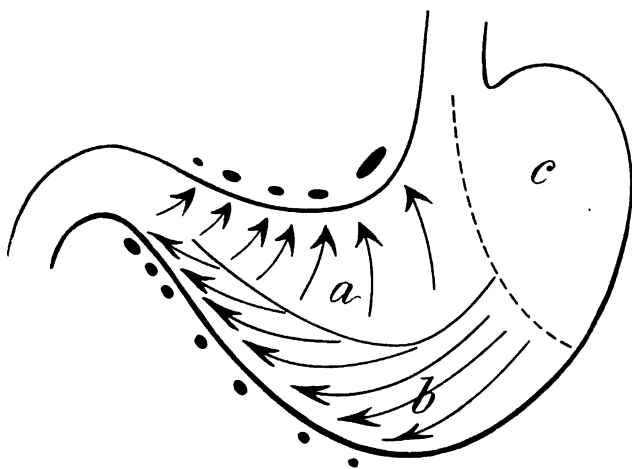


Fig. 110.—The lymphatic areas of the stomach: *a*, The area from which the lymphatic vessels drain into the coronary glands; *b*, the area from which the vessels drain into the glands along the greater curvature; *c*, the "isolated" area.

least important of all, for they drain only the "isolated" area of the stomach. One or two small glands lie in the hilum of the spleen and in the gastrosplenic omentum. They draw their afferents from the left half of the greater curvature and from the fundus; their efferents go to the next group.

The main group lies along the trunk of the splenic artery, at the upper border of the pancreas; they are the left suprapancreatic glands. They draw afferents from the glands in the hilum of the spleen, and also vessels directly from the fundus of the

stomach. Their efferents discharge into the glands at the coeliac axis.

IV. **The glands in connexion with the coeliac axis** are the recipients of afferent vessels from all the gland groups previously described. They are few in number, large in size, lie in the fork formed by the coronary artery and the splenic artery as they arise from the coeliac axis. Some of their efferents discharge directly into the receptaculum chyli, and others pass behind the pancreas to the glands lying in the root of the mesentery.

Fig. 111 —Diagram to shew the mode of spreading of a pyloric cancer, the lymphatic invasion, and the line of division of the stomach in partial gastrectomy. Note especially that the whole of the lesser curvature is removed. The arrows indicate the direction of the lymphatic currents.

From the above description it will be seen that two varieties of glands may be described in respect of their vascular afferents. There are glands which receive vessels directly from the stomach, there are others which receive only the efferents vessels from other glands. The former glands are described as "*primary*," the latter as "*secondary*." There are certain groups which are both primary and secondary, receiving some vessels direct from the stomach, and other vessels from glands adjacent to them.

The distinction between the primary and secondary glands is of the highest importance from the surgical point of view, be-

cause it is clear that if any operative treatment of carcinoma of the stomach is to be considered radical, the first cordon of glands at least must be removed along with the growth. Leaving aside the "isolated area" of the stomach, wherein primary growths are almost unknown, and invasion by growths commencing elsewhere is very rare, the primary glands are:

- The lower coronary.
- The upper coronary.
- The right paracardial.
- The suprapyloric.
- The right suprapancreatic.
- The gastro-epiploic, upper and lower.
- The retropyloric, when present.

In cases of cancer of the pylorus or prepyloric region all these glands may be invaded by growth conveyed along vessels directly from the stomach. To the affection of these primary glands Cunéo gives the name "*immediate adenopathies*"; to the affections of the secondary glands, the name "*distant adenopathies*." Jamieson and Dobson describe an additional primary gland. They have found a vessel which, arising from the upper border of the pylorus, separates itself from other vessels, and turns to the right behind the duodenum, to end in a gland lying behind the head of the pancreas, on the lower end of the common duct, a gland of the biliary chain. Polya and von Navratil in one case found an efferent vessel going from a retropyloric gland to a gland in the hilum of the liver.

Glandular invasion occurs early in cancer of the stomach. According to Cunéo, it is found in all cases at autopsy and in 87.5 per cent. of the specimens removed by gastrectomy. To determine the existence of carcinoma a minute examination of the glands microscopically is necessary, for, as Carle and Fantino ("Archiv. f. klin. Chir.," 1898, lvi, 226) have shewn, the glands may be found grossly enlarged, yet not invaded by growth, whereas small glands are found full of growth. The invasion of the glands of the lesser curvature is that most commonly found;

it is present, according to Cunéo, in 91.4 per cent. of cases (operation specimens); the glands of the greater curvature* are affected in 62.5 per cent. of cases.

There are certain features of carcinoma of the stomach other than those connected with the glandular implication which it is essential to bear in mind in planning and in carrying out a "radical" operation. These are concerned with the local enlargement of the growth, the invasion of the lesser curvature, and the invasion of the duodenum. Cunéo and Borrmann have studied these points with conspicuous care.

1. *The Local Increase of the Growth.*—When the growth is inspected from either its mucous or serous surfaces, no adequate idea of its real size is obtained, for it is in the submucous layer that the widest extension takes place. For some distance beyond the edge of the palpable or visible growth a vertical section of the stomach-wall shews a continuous infiltration of the submucosa, and beyond this scattered nodules may be seen, nodules which, according to Borrmann, are still connected with the main growth. The extent of this submucous invasion cannot be predicted, but it is never safe to allow for it a margin of less than 3 cm. (Cunéo) when the division of the stomach is made in partial gastrectomy.

2. *The invasion of the lesser curvature* is very pronounced in the great majority of cases. In Borrmann's series of 63 cases he found the following disposition.

The two curvatures were equally invaded in 32 cases—52 per cent.

The greater curvature was more invaded than the lesser in 19 cases—30 per cent.

*It is sometimes said (see Jamieson and Dobson, page 1065) that there is a great discrepancy in the estimates of the frequency of glandular complications in the statistics of Cunéo and Lengemann. The fact is not realised that Lengemann's percentages refer to the number of glands affected out of the total number of glands which were present, whereas Cunéo's percentages refer to the number of cases in which any glandular involvement occurs. If Lengemann's cases are examined in the same manner as Cunéo's (as is easily done, full details being given), it will be found that their results are almost identical.

The lesser curvature was free in three cases.

The greater curvature was free in 1 case.

Both curvatures were free in 1 case.

Cunéo found the lesser curvature affected in 19 cases out of 22, and explains the discrepancy between his figures and Borrmann's as being due to the shrinkage the lesser curvature rapidly undergoes after removal of the specimen from the body. The greater implication of the lesser curvature is to be expected if the commonest place of origin of the growth is borne in mind. Cunéo has shewn, moreover, that the extension of the growth along the lesser curvature is in reality an invasion of the stomach along the lymphatic vessels. The removal of the whole length of the lesser curvature is, therefore, an essential part of any operation, as v. Mikulicz, and those who worked under him—Most and others—were the first to shew.

3. *Invasion of the Duodenum.*—From the time of Rokitansky and Brinton to Mikulicz and Most, all observers commented upon the integrity of the duodenum in cases of cancer of the stomach. This integrity is more apparent than real. Carle and Fantino shewed that in many of their cases the bowel was involved, and Cunéo and Borrmann have demonstrated the frequency and the extent of this invasion. In 11 cases examined by Cunéo the duodenum in 7 was healthy, in 4 it was invaded, but in only 1 case was the disease found 1 cm. beyond the pylorus. Borrmann, in 63 cases, found the duodenum invaded in 19 cases; in 9 of these the bowel was diseased at the point of section; in 2 cases the disease extended over 2 cm. in a continuous growth onwards from the pylorus. The indication, therefore, is that the removal of the whole of the first portion of the duodenum is necessary in all cases of gastrectomy for carcinoma. Some information of value is to be derived from an examination of those specimens, removed by partial gastrectomy, in which it is evident that the operation has been incomplete. Borrmann, in his exhaustive examination of 63 specimens (p. 333), found no less than 20 in

which it was evident that a complete removal of the growth had not been accomplished. In these 20 cases there were 13 in which the incompleteness was on the side of the lesser curvature, in 8 at the cardiac end, in 1 at the duodenal end, and in 4 at both ends.

In 2 cases the greater curvature had been too scantily removed, in 1 on the stomach side only, in the other, both on the stomach and the duodenal sides.

In 5 cases both lesser and greater curvatures were insufficiently removed. In 2 this insufficiency involved the duodenal extremity above and below, and the lesser curvature; in 1 the duodenal extremity above and below; in 2 the cardiac end of the two curvatures; that is to say, that in 16 of the 20 incomplete operations it was the lesser curvature that was involved, and in 9 of the 20 it was the duodenum. On the other hand, it was only in 4 cases that the greater curvature on the stomach side was involved.

After a study of all the facts previously discussed, we are in a position to lay down the lines upon which an operation for the removal of a malignant growth beginning in the pyloric region of the stomach should be based. It is essential that the whole growth should be taken away, and such a margin beyond the visible and palpable tumour as shall ensure that the outlying nodules are within the lines of section; that all the lesser curvature should be removed; that one half of the greater curvature should be removed; that an inch at least of the duodenum should be removed; that all the "primary" glands at least should be taken (these are the lower and upper coronary, the right paracardial, the suprapyloric, the right suprapancreatic, the right gastro-epiploic, upper and lower, and the retropyloric). The removal of all these parts is possible, and therefore the somewhat mournful view of the possibilities of the surgical treatment of cancer of the stomach taken by Lengemann, Polya and von Navratil, Jamieson and Dobson, is not justified. The difficulties to be encountered will chiefly lie in the removal of

the right suprapancreatic glands, but that these difficulties are exaggerated is, I think, quite certain. In several cases I have, by using the "gauze stripping" method, removed the glands without any injury either to the hepatic artery or to the pancreas.

The following are the details of the operation of partial gastrectomy:

PARTIAL GASTRECTOMY.

The operation is carried out in the following manner: An ample incision is made in the middle line, reaching, as a rule,

Fig 112 —Gastrectomy shewing the ligature of the pyloric artery and vein.

from the ensiform cartilage to the umbilicus. The central incision is more convenient than the lateral incision, which is commonly employed for the operation of gastro-enterostomy; it gives easier and more immediate access to all parts of the operation area. An inspection of the extent of the cancerous invasion of the stomach itself, of its adhesion to the pancreas or abdominal wall or liver, of the number and position of any glandular enlargements, and finally of the liver, peritoneum, and parts immediately

in the neighbourhood to discover if secondary growth be present, is rapidly and carefully made. Neither adhesions nor the involvement of lymphatic glands preclude removal of the stomach, though they may render the mechanical difficulties rather more serious. When a resection has been decided upon, flat gauze

Fig. 113.—Partial gastrectomy. The growth is shewn, and the position in which the gastro-epiploic artery is secured on the greater curvature.

swabs, wrung out of hot saline solution, are packed around the stomach so as to afford a barrier between the field of work and the general peritoneal cavity. As a rule, two layers of swabs are introduced, the first consisting of very large ones, which are unchanged throughout the operation, and the second of smaller ones, which, when soiled, are changed at once. No care is too

punctilious so long as absolute security of the peritoneal cavity is ensured.

Around the wound edges the rubber and gauze squares are tucked. The transverse colon with the omentum is allowed to lie out of the abdomen with the stomach, in order to render easier the manipulations concerned with securing the integrity of the middle colic artery. During the time the colon is not engaged immediately in the operation it is covered with a rubber and gauze sheet kept moist and warm. I find it a great convenience to make at once the opening in the transverse mesocolon which will presently be used for the purpose of enabling the jejunum to be passed through it when the anastomosis with the stomach is made. Through this opening the finger can from time to time be passed, and in this manner the exact position of the middle colic artery and of the gastroduodenal artery can be determined.

The first step in the operation consists in tearing through the gastrohepatic omentum close to the liver. As a rule this structure is of exceeding tenuity, and its vessels require no ligature, but occasionally, and especially towards the pyloric end of it, one or more little vessels may need to be secured. At once the fingers of the left hand pass into the lesser sac, and feeling behind the stomach are able to ascertain whether any inseparable adhesions exist between the stomach and the pancreas, and generally to determine the conditions of the growth on its posterior aspect.

The arteries which supply the stomach are then secured. It was formerly my practice to secure the coronary artery at the very first, but this is by no means easy, and is indeed very unsatisfactory; for, approached from the front, it is physically impossible to ligature the vessel close to its origin from the coeliac axis. The highest possible point should be chosen for the division of the artery, otherwise the highest group of coronary glands, which we know to be primary, will be left behind. The early ligature of the coronary artery is then not only difficult, but it is dangerous and inefficient and a ligature applied to it at

the beginning of the operation may slip and sharp hæmorrhage, not easily controlled, may occur. The first vessel to be secured, then, is the pyloric artery, which is given off close to the upper border of the pylorus, by the hepatic artery. It may arise separately or in a common trunk with the gastroduodenal artery; if separately, it is surrounded by a double ligature and divided as far away from the stomach as possible. From the point of section a cut or tear is made through the peritoneum above the pylorus and the first part of the duodenum, in such manner as to secure that all the glands and fat are stripped upwards to the stomach. Care is taken not to wound the common duct.

W. J. Mayo mentioned ("Jour. Amer. Med. Assoc.," 1910, i, 1608) that in one case of his the duct was wounded, and bile drained from it for some days. The left forefinger is then passed behind the duodenum from above downwards, separating the first part of the intestine from the pancreas, and is made to project at the lower border of the bowel, well to the right of the subpyloric group of glands. As the finger is withdrawn two clamps are passed along its track, and the duodenum is firmly embraced by them both. The distal clamp is of the curved pattern shewn in the figure, the blades being grooved longitudinally. The duodenum is then cut across about 1 inch from the pylorus, as close to the distal clamp as possible, the knife shaving the bowel off so that nothing projects beyond the blades. At once the mucosa of the proximal end is thoroughly cauterised and rendered sterile. To prevent the clamp from slipping, a couple of ligatures may be passed through the stomach on the cardiac side of the clamp and tied over the clamp blades. At this point, as the cut end of the duodenum is turned over to the left, the gastroduodenal artery may be seen to give off the right gastro-epiploic artery, and one or other of these vessels is now secured. As the aneurysm needles surround the vessels, the colon and omentum are turned upwards so as to display the middle colic artery, which must be clearly seen to be intact.

The distal end of the duodenum is now closed in the following manner (Parker-Kerr method, slightly modified):

The clamp is held vertically in the right hand of the assistant, with the tip of the blades pointing to the surgeon's right. The suture begins at the extreme upper border, on the left of the clamp.



Fig 114.—Author's clamp, modified from the Parker-Kerr clamp, for use in closing the cut end of the duodenum or other parts of the small intestine.

Here a stitch is taken, about $\frac{1}{3}$ inch from the clamp, and at right angles to it. The needle, when withdrawn, is taken across the front of the clamp blades, while the clamp itself is twisted by the assistant over to the left so as to make the surface of the bowel to the right of the clamp present. In this a turn of the needle is

taken, about $\frac{1}{4}$ inch from the clamp, parallel to it, and starting as close to the upper edge as possible. This stitch is drawn tight, so that a thread is now seen to pass over the front of the needle, from the first to the second turn of the needle. Again the

Fig. 115.—Partial gastrectomy. The pyloric artery has been secured, and the gastrohepatic omentum divided (fewer ligatures than are shewn are generally sufficient). The gastro-duodenal artery has been secured and the duodenum is about to be divided. The smaller drawings shew the method of closure of the duodenal end.

clamp is twisted by the assistant until the left side of the bowel presents, and in this a turn of the needle is taken about $\frac{1}{4}$ inch from the clamp, and parallel to it. So the stitch proceeds, first on one side of the bowel and then on the other, as the clamp is

turned in the assistant's hands and each aspect of the bowel is made prominent. The last turn of the needle is taken on the side opposite to that on which the stitch began, and it is longitudinal (as was the first turn), the needle being entered near the clamp, at its tip, and taken along the bowel in a direction away

Fig. 116 —Partial gastrectomy. The duodenum closed. The gastrohepatic omentum divided.

from the clamp. The stitch is then grasped at each end by the surgeon, while the assistant opens and disengages the clamp. Then at once the stitch is drawn tight by pulling with both hands, and instantly the cut edges infold, and the closure of the bowel is secure. The suture is then made to return along the bowel to the starting-point, where it is knotted and drawn tight,

so that the cut end of the gut puckers up very tightly. I generally introduce one or two interrupted sutures over the dimpled end of the bowel, though probably this is not necessary, and finally one or two sutures are passed through the pancreas and the duodenum, so as to make the closed end of the bowel fit accurately against the anterior surface of the head of the gland.

Fig. 117.—Partial gastrectomy. The stomach, wrapped in gauze, is turned over to the left, and the coronary artery is now easily secured close to the aorta. This is the only method by which the artery can be easily tied at a point sufficiently high to ensure that the primary glands which lie on the vessel are below the point of division.

The next step consists in the division of the gastrocolic omentum along the greater curvature of the stomach, or rather along, and as close as possible to, the upper margin of the transverse colon. The concavity which the duodenum makes in its second portion is cleaned of all the fat which lies within it, fat which contains often-times one or more possibly affected glands. It is most important to see that this subpyloric group of glands and all the

"dropped glands" from this group lying in the gastrocolic omentum are included in the parts to be removed. As the stomach is lifted away from the pancreas a few retropyloric glands may be seen, or some adhesions to the pancreas discovered. These adhesions may be light and easily divided, or they may be firm and inseparable. If the latter, then it is better not to tear

Fig. 118.—Partial gastrectomy. The coronary artery being divided, the "anchor" which held the stomach has gone. The stomach is now turned well over to the left, and gastro-enterostomy performed. It is quite easy to do this, because the hold on the stomach allows it to be drawn up and retained easily in position.

them away from the pancreas, but with a sharp knife to take a superficial shaving from the gland. There is no danger in this, provided that the duct of the gland is not reached. There may be a little bleeding but a hot, moist swab, or a few fine sutures of catgut soon cause its arrest. A series of ligatures is passed by the

aid of the aneurysm needle, through the gastrocolic omentum from right to left and as the needle lies in position for each ligature the transverse colon and the omentum are turned upwards so as to make sure that the trunk of the middle colic artery is not

Fig. 119.—Partial gastrectomy. The dotted line shews the position of the gastro-enterostomy, which has already been performed. The clamps are placed on the stomach, between them the stomach is divided. The line of section and the gastro-enterostomy opening are generally made about 1 inch further to the left than is shewn in the figure.

embraced. It is impossible to emphasize too strongly the need for care and caution in this matter. Operators, so distinguished and so careful as Kocher and Finney, have ligatured the middle colic artery with the result that gangrene of the colon has occurred, or such pallor or lividity of it has been seen before the

completion of the operation that a resection of the intestine involved has been necessary. One after another the ligatures are passed, below the arch of the gastroepiploic vessels, until the mid-point of the greater curvature of the stomach is reached. Beyond this point, for the reasons already given, it is not necessary to go. At this point, therefore, the gastroepiploic vessels are ligatured and divided. The ligature of these large trunks is best done, I think, at this stage of the operation, though I have many times placed a preliminary double ligature at this point, before the duodenum is cut across.

As soon as this stage in the operation is reached, it will be found easy to turn over the stomach to the left, the posterior surface being now to the front, so that the anterior surface of the pancreas is seen in all its length. Into the lesser sac a large hot swab is now, or at an earlier stage of the operation has been, packed. By pulling a little forcibly on the stomach the origin of the coronary artery from the cœliac axis is now readily seen and felt. It is a perfectly simple matter to surround it with an aneurysm needle and to ligature it in two places close to its origin. The upper coronary group of glands must remain with the stomach when the vessel is divided, and to make sure of this it is as well to strip the glands downwards from the vessel and to leave the trunk quite bare. On the instant that the vessel is divided the stomach, freed from its main anchorage, is readily drawn downwards and can be more easily turned over to the left. While it is held in this position the anastomosis with the jejunum is made. It is now quite easy to do, for the stomach, held in the assistant's hand, cannot slip away from the clamp. If the gastro-enterostomy is performed after the stomach has been divided, it is often a matter of extreme difficulty to grip the posterior wall of the stomach with the clamp in exactly the position required, and it is a still more difficult matter to prevent it from slipping away. A small rent is made in the transverse mesocolon, and the first few inches of the jejunum are drawn through. The clamps are applied to the stomach and jejunum in such manner that the open-

ing which is to be made in them is antiperistaltic—it runs, that is to say, obliquely from the lesser curvature above downwards and to left to the greater curvature. By making the anastomosis in this way a rather larger portion of the stomach may be removed. Curved clamps are more easily applied than straight ones.

The anastomosis is now performed in the ordinary manner.

Fig. 120. —Partial gastrectomy. Closure of the stomach. The anastomosis with the jejunum is seen.

When it is completed, the time has come to sever the stomach. This is done between two pairs of large curved clamps, which are applied so that their convexities lie towards the pylorus. When placed in this manner, the lesser curvature of the stomach is gripped at its very highest point. If the clamps are placed with the convexity to the left, it will be found that the tip of the highest one does not securely grip the œsophageal portion of the

lesser curvature. I have once had great difficulty at this point in the operation as a result of the upper end of the divided stomach receding from the clamp. To prevent this the reverse application of the clamp is possibly quite sufficient, but in addition I always introduce, before the stomach is divided, at the highest point, one or two sutures, which take the posterior and the anterior walls on each side of the line of the intended incision. By holding these firmly upwards the stomach is absolutely prevented from retraction. When the clamps are secure, the stomach is cut across about $\frac{3}{4}$ inch distal to the line of the gastroenterostomy opening. The serous and muscular coats are first divided, back and front, and are pushed backwards from the mucosa, which is then divided as near as possible to the proximal clamp. The whole length of the mucosa is now thoroughly cauterised, or still better, wiped with pure carbolic acid. A catgut suture, which takes all the coats, is introduced, beginning at the lesser curvature and ending at the greater. It is an interlocking suture, the individual turns of which are placed close together, and the catgut at each turn is drawn as tight as possible. This, as a rule, secures all vessels, but if, when the clamp is loosened, any bleeding point is seen, it is secured with a separate stitch or a ligature. A second line of sutures is now inserted. A continuous thread of Pagenstecher's material is used, and extends from the lesser to the greater curvature, infolding the former line of sutures securely. The needle is introduced on each surface of the stomach about $\frac{1}{2}$ inch from the former suture line, so that the cut end of the stomach is deeply infolded.

At the lower end it has sometimes been a matter of difficulty to me to secure a quite satisfactory appearance of closure. Recently, instead of continuing the running suture the entire length of the incision, I change its character about an inch from the end, and here pass the needle three or four times in the direction of the suture line, about $\frac{1}{2}$ inch away from it on the anterior surface, downwards to the greater curvature, and then upwards

along the posterior surface at the same distance, so as to surround the last inch or so of the divided edge of the stomach by a purse-string suture. As this suture is tightened the suture line is pressed inwards and buried. A few more interrupted sutures may here and there be necessary and finally the two interrupted sutures applied at the lesser curvature before the stomach was cut across are tied.

Glands are now sought along the hepatic artery at the upper border of the pancreas—the right suprapancreatic glands. As a rule, none are found, but if any be discovered, they can be stripped away by gauze pressure, especial care being taken to avoid any damage to the trunk of the hepatic artery. The operation area is now wiped gently over with hot moist swabs. The omentum and the transverse colon are turned upwards, the jejunum at its origin pulled upon, until the gastro-enterostomy line is seen, and the edges of the divided mesocolon are then stitched to the gastrojejunal suture line in the usual manner. A final inspection of the whole area is made, and the omentum then turned vertically upwards to lie over all the operation area and to make all the rough places smooth. The blood lost by the patient in this operation, from beginning to end, should be less than an ounce. Drainage is not necessary unless the pancreas has been deeply injured or the common duct wounded.

The immediate union of the duodenum to the stomach by the method of Billroth and Kocher is not to be recommended. It is not easy to accomplish even after the duodenum has been mobilised—it leads to parsimony in the removal of diseased areas, and is apt to be followed by a stenosis at the new opening which may call for the performance of gastro-enterostomy in the future stages. Throughout the operation the nicest care is taken to avoid loss of blood, the exposure of viscera, and the contamination of the operation area. Every manœuvre is carried out with the daintiest and most delicate manipulations. Rough handling or rough wiping, indeed, roughness of any kind, is to be scrupulously avoided. Here, as always in the abdomen, the light hand is es-

stantial. Patients who need this operation are often seriously wasted, and their tissues are drained of all fluids. Their appearance often suggests desiccation. It has fallen to me very often to operate upon such wasted patients, and in order to supply them with fluid I have passed a stomach-tube through the gastro-

Fig. 121. Kocher's method of uniting the duodenum to the posterior surface of the stomach after partial gastrectomy.

enterostomy opening as soon as it is made. The tube passes 6 or 10 inches into the jejunum, and through it two pints of peptonised milk with a little brandy are slowly poured, while the subsequent stages of the operation are completed, and the parietal wound is being secured. The patient, indeed, is having a good

meal during the time that his stomach is being cut away. As soon as the patient returns to bed, as a matter of routine, the continuous administration of saline fluid by the rectum is begun and is continued for twenty-four or forty-eight hours. It is really astonishing to see how fresh and bright a patient looks who is in this manner well supplied with fluid. There is, as a rule, little or no shock after this operation, which lasts an hour, or a little longer, in the ordinary case.

In the matter of oral feeding, the customary routine after gastro-enterostomy is followed; the patient, that is to say, is allowed fluids in unrestricted quantities. It is fluid the patient needs, and the more he can take, the better.

In some cases anterior gastro-enterostomy may have to be performed instead of the posterior operation. Since I adopted the method described above, the performance, that is, of the gastro-jejunal anastomosis before the detachment of the stomach, I have never had to resort to the anterior method. Should it ever be necessary, the usual procedure is, so far as possible, carried out, a point on the jejunum about 15 to 18 inches below the flexure being chosen for the new orifice.

Instead of closing the cut end of the stomach and making an opening from the posterior surface of the stomach to the jejunum, Reichel and Wilms have suggested that the cut end of the stomach should be united in all its length to the jejunum. I have no experience of the method.

CHAPTER XVI.

THE CHOICE OF OPERATION IN CANCER OF THE STOMACH.

In Pyloric Cancer.—Surgeons of some experience in operations upon the stomach are divided in their opinions as to the better operation in cases of malignant disease of the pylorus. On the one hand are those who, believing that a diagnosis of malignant disease cannot be made while yet the disease is local, advocate a palliative operation,—gastro-enterostomy,—with the idea of giving rest to the diseased area, and thereby retarding growth, as in colotomy for malignant disease of the rectum. On the other hand are those who, having been tempted to employ a radical operation in some favourable case or series of cases, are so impressed with its advantages that they become apostles of a broader creed and advocate local extirpation. My opinion emphatically is that, *in all cases, whenever possible, a radical operation should be attempted.* Under present conditions of diagnosis the probability is that, when a patient is submitted to operation, gastro-enterostomy is, in general, a safer operation than pylorotomy. But although the comfort and sense of well-being of the patient may improve very decidedly for a time after the former operation, the tumour is still slowly enlarging in size, and will eventually cause death. How much of the general ill health, cachexia, and so forth are induced by absorption from the growth, by necrotic changes in its mass, by ulceration and hæmorrhage upon the surface, is quite unknown, but one may presume that such influences are not trivial. Krokiewicz and Pilliet believe, indeed, that cancer cachexia is the result of intoxication with the by-products of metabolism of the cancer-cells. A local extirpation, then, even if followed by a recurrence, will probably prolong life for a greater period and in greater comfort than a gastro-enterostomy. It

was doubtless an opinion similar to this which led Terrier to remark that "the best form of gastro-enterostomy was done after removal of the pylorus." But increasing experience in the most competent hands tends to shew that in properly selected cases pylorectomy is *not* an operation of very grave risk, and *is* an operation of generous promise.

Partial gastrectomy in the early days of its employment was an exceedingly serious operation, with an appalling death-rate. Latterly the mortality is seen to be a gradually, but persistently, diminishing one.

In order to form some estimate as to the chances of life, of the condition of health, and of the relative values of different operations in patients afflicted with malignant disease of the stomach, it is desirable to enquire closely into the records of a number of cases, preferably in the practice of one surgeon, observed over a series of years. The fullest account of the surgical side of the question has been given by Krönlein, of Zürich, and by von Mikulicz, of Breslau. The questions that are in urgent need of settlement are the following:

1. Will a palliative operation upon the stomach prolong life?
2. Will it make the remnant of life more tolerable? Will it make the patient feel that the ordeal of operation is justified in the greater comfort of his later days?
3. Will a resection give a reasonable prospect of cure?
4. Will a resection, if followed by recurrence, give increased length of days and better health?

It is necessary, in fact, to know whether, in the stage in which we now meet with the cases, an operation is worth doing, and, if it is, whether it should be palliative, or whether an attempt should be made to eradicate the disease.

In order to have some means of comparing the surgical cases with those not operated upon, it is necessary that exact details should be kept of all cases coming to the surgeon, whatever their destiny—to operation, to internal medication, or to absence of treatment—may chance to be.

Krönlein tabulates the cases which came under his observation from April 1, 1881, to February, 1902. All the cases were recorded, without exception. There were 264, and the following table gives a brief sketch of their classification:

A. NOT OPERATED UPON.

1. Inoperable.....	53
2. Refusing operation.....	14
Total.....	67

B. OPERATED UPON.

		DEATH UNDER OPERATION.
1. Exploratory laparotomies.....	73	7— 9.5 per cent.
2. Gastro-enterostomies.....	74	18—24.3 “ “
3. Gastrectomies.....	50	14—28.0 “ “
Total.....	197	39—19.8 “ “

Of the 264 patients, all but 13 were traced. Of these 13, the majority had not been treated by operation, and not one of them had been submitted to gastrectomy.

The fate of these patients is shewn in the following table:

Not traced.....	13
Dead.....	229
In consequence of operation.....	39
Later, from intercurrent disease.....	2
“ from suicide.....	1
“ from the primary carcinoma.....	166
“ from recurrence after gastrectomy.....	21
Living.....	22
Gastro-enterostomies.....	9
Gastrectomies.....	13
Total.....	264

Of the 264, it will be seen that 67 were not operated upon (25.3 per cent.). In 53 of these an operation was contra-indicated; in 14 it was refused by the patients.

Of the 264, 73 had exploratory laparotomy performed (27.6 per cent.). After the surgeon had opened the abdomen and had become convinced of the impossibility of radical extirpation, the abdominal wound was closed.

Of the 73 patients, 7 died within the first week after operation

(4 from exhaustion, 2 from pneumonia, and 1 from pulmonary embolism).

In 74 patients gastro-enterostomy was performed. At first sight this number appears small, but Krönlein has laid it down as a rule of his practice that in cases of carcinoma of the stomach, where extirpation is impossible, the palliative operation of gastro-enterostomy shall not be performed, unless there is evidence of stenosis. If this evidence fails, the operation becomes merely "exploratory." The only exception that has been made is in those cases in which there has been marked stagnation of food without evidence of stenosis. Of the 74 gastro-enterostomies, 18, or 24.3 per cent., died under the operation.

Fifty patients were submitted to the operation of gastrectomy. Of these, 14 died in direct consequence of the operation. Of the total 264 cases, therefore, only 18.9 per cent. underwent the radical operation. One of the 50 was the well-known case of total extirpation of the stomach performed by Schlatter.

The subjoined table shews the percentage in which each form of operation was attempted:

264 CASES.

No operation in.....	25.3 per cent.
Operation in.....	74.7 " "
Exploratory.....	27.6
Gastro-enterostomy.....	28.0
Gastrectomy.....	18.9

OPERATION MORTALITY.

Exploratory laparotomy.....	9.5 per cent.
Gastro-enterostomy.....	24.3 " "
Gastrectomy.....	28.0 " "

In order to obtain a comparison between the life-chances of those patients who survive operation and those who are not operated upon, it is necessary to cancel the following:

Patients who withdrew after examination.....	13
" " did not survive operation.....	39
" " died of intercurrent disease.....	2
" " committed suicide.....	1
Total.....	55

Deducting these 55 from the total of 264 we have 209 patients, who may be classified thus:

A. NOT OPERATED UPON.

1. Inoperable.....	51	
2. Declining operation.....	12	63

B. OPERATED UPON.

1. Exploratory laparotomy.....	58	
2. Gastro-enterostomy.....	54	
3. Gastrectomy.....	34	146

Total.....		209
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The report as to these 209 cases at the beginning of March, 1902, when these enquiries were concluded, was as follows:

Died from carcinoma of the stomach.....	187
Living.....	22

There died:

A. OF THOSE NOT OPERATED ON.

1. Inoperable cases.....	51	
2. Declining operation.....	12	63

B. OF THOSE OPERATED ON.

1. All the exploratory laparotomies.....	58	
2. Of the gastro-enterostomies.....	45	
3. Of the gastrectomies.....	21	124

Of those operated on and not operated on.....		187
-----------------------------------------------	--	-----

There are still living:

1. Of gastro-enterostomies.....	9	
2. Of gastrectomies.....	13	22

Total.....		209
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The duration of disease in patients suffering from carcinoma of the stomach was also reckoned. It was found that, on the average, the time from the first onset of symptoms up to the day of the patient's admission to the hospital, or up to the day of operation, was from eight to nine months. Means were also taken to discover the number of days from the patient's admission or from the date of operation to the patient's death.

The duration of time from entrance into hospital (time of operation) to date of death:

- A. In the non-operated cases.....102 days.
- B. In the operated cases:
 - 1. Exploratory laparotomies.....114 "
 - 2. Gastro-enterostomies.....193 "
 - 3. Gastrectomies.....520 "

If in these groups we sum up the values found for both periods of duration of the disease, we gather the following to be the average time for the whole duration of the carcinoma from the onset of the first symptoms until time of death:

- A. In the non-operated, 9 months and 102 days—about 12½ months.
- B. In the operated cases:
 - 1. Exploratory laparotomies, 9 months and 114 days, or 13 months.
 - 2. Gastro-enterostomies, 9 months and 193 days, or 15½ months.
 - 3. Gastrectomies, 9 months and 520 days, or 26½ months.

Krönlein, from this experience, draws the following conclusions:

1. That carcinoma of the stomach without operation has a fatal termination in about a year.
2. That gastro-enterostomy prolongs the life of the patients suffering from this disease for about three months, on the average.
3. That gastrectomy, so far as it is followed by recurrence, prolongs life on an average about fourteen months.

At the time this report was published there were 22 patients still living after operation. Of these, 9 were cases of gastro-enterostomy and 13 of gastrectomy. The former will, of course, prove fatal within a few months. So far as the latter are concerned, their length of life since operation is shewn in the following table:

1 case is	in the eighth	year since gastrectomy.
1 case "	"	fourth " " "
2 cases are	"	third " " "
3 " "	"	second " " "
6 " "	"	first " " "

Von Mikulicz, in 1901, published the results of his experience from April, 1891, to March, 1901. During this period 458 cases of cancer of the stomach had been under observation in the clinic at Breslau. This number includes 46 cases of cancer of the cardia. The diagnosis was confirmed either at the operation, or by observation of the progress of the disease, or by examination after death. In several cases of cancer of the cardia the diagnosis was confirmed by œsophagoscopy or by the removal and examination of a small portion of the growth. In 128 cases no operation was performed, chiefly because radical removal was no longer possible, and because there was no indication for any palliative procedure, such as gastro-enterostomy. In exceptional cases the operative interference was declined by the patient. The total duration of life from the commencement of the disease (as inferred from the symptoms in 67 cases in which it was possible to ascertain the facts) varied from a few months to 38 months—an average of $11\frac{1}{2}$ months.

In 320 cases recourse was had to operation as follows:

1. Simple exploratory incision.....	44
2. Gastrostomy (in cancer of cardia).....	27
3. Jejunostomy.....	12
4. Gastro-enterostomy.....	143
5. Resection of stomach.....	100
6. Extirpation of stomach.....	3

Exploratory Incision.—Four deaths followed this operation, giving a mortality of 9 per cent. The average duration of life after operation was $4\frac{8}{10}$ months, and from the beginning of the disease, $14\frac{8}{10}$ months. If the cases submitted to exploratory laparotomy be added to those in which no operation was performed, we get an average duration of life of a little over 13 months from the beginning of the disease, a figure which is adopted by the author as a basis for judging of the results of the operative treatment of gastric cancer.

Gastro-enterostomy.—There were 48 deaths in 143 cases—a mortality of $33\frac{1}{10}$ per cent. Although during the last three years the mortality has been reduced to $26\frac{1}{2}$ per cent., it is still very

high in proportion to the same operation in non-cancerous conditions. The average duration of life after operation was $6\frac{4}{10}$ months, and from the beginning of the disease, 14 months; but if the operation deaths are included, this is reduced to $12\frac{3}{10}$ months, slightly shorter than the duration of life when no operation is performed.

Resection of the Stomach.—There were 37 deaths in 100 cases. In the last three years the death-rate has been reduced to 25 per cent.; that is to say, a mortality slightly lower than that of gastro-enterostomy. The results, as observed in 58 patients who survived the operation, and whose subsequent history is known, are as follows: 20 are still alive between 6 months and $8\frac{1}{2}$ years:

Longer than 1 year, 17 are alive.
 " " 2 years, 10 " "
 " " $3\frac{1}{2}$ years, 4 " "

These last four may be regarded as radically cured. The author regards these results as quite as good as those after operations for cancer of the tongue or rectum.

It will thus be seen that there is no great divergence in the results taken from the two clinics, allowing for the fact that the number of cases in the one is almost double that in the other, while the period covered by the observations is only one-half. Krönlein records 264 cases extending over 21 years; von Mikulicz, 458 in 10 years. The results may be compared in this way:

	KRÖNLEIN. MONTHS.	MIKULICZ. MONTHS.
The non-operated cases lived, from the beginning of the disease.....	12½	11½
The cases treated by exploratory laparotomy..	13	14½
The cases treated by gastro-enterostomy	15½	14
The cases treated by gastrectomy	26½	24½

In comparison with these statistics quoted from Mikulicz and Krönlein I will offer those given by W. J. Mayo ("Jour. Amer. Med. Assoc.," 1910, i, 1908), which may be taken as representing the highest modern achievements. In the Mayo Clinic

from April 21, 1907, to January 27, 1910, the cases of cancer of the stomach treated by operation are arranged as follows:

Total number.....	627
Explorations—hopeless condition found.....	206
Gastro-jejunostomy performed.....	169
Gastrostomy.....	26
Excision of ulcer (cancerous changes being found).....	2
Resection for cancer.....	224

The appended details of the cases of partial gastrectomy are given:

TABLE 1.—OPERATIONS FOR CARCINOMA INVOLVING THE PYLORIC END OF THE STOMACH

Total number.....	224
Males.....	163
Females.....	61
Age of oldest.....	81
Age of youngest.....	30
Average age.....	53

PATIENTS OPERATED ON OVER FIVE YEARS AGO.

Total number.....	50
Present condition known.....	39
Alive and well (one eight years, two and one-half months; one eight years; *one seven years, two months; one six years eleven months; one five years, three and one-half months; one five years).....	6

PATIENTS OPERATED UPON OVER FOUR YEARS AGO.

Total number.....	85
Present condition known.....	64
Alive and well.....	13

PATIENTS OPERATED UPON OVER THREE YEARS AGO.

Total number.....	117
Present condition known.....	88
Alive and well.....	18

PATIENTS OPERATED UPON LESS THAN THREE YEARS AGO.

Total number.....	107
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Cases in the last group (operations less than three years ago) are too recent to be of any statistical value as to the question of cure.

A careful study of the wealth of experience laid bare in these records will enable us more clearly to formulate our ideas as to the

*Has since died of recurrence.

principles that should guide us in dealing with this most serious disease. In the first place, it must be admitted that our means of obtaining cases sufficiently early are almost as meagre as it is possible for them to be. Until more accurate methods of diagnosis are established, it is absolutely imperative that recourse should be had earlier and more often to the exploratory laparotomy. At present that operation is limited to the examination of patients when the diagnosis has been made, and when the only question to be settled is whether or not the growth is removable. But in order to better our results we must explore, not to *confirm*, but to *make*, a diagnosis.

When the diagnosis has been made and the patient is submitted to operation, it is difficult to decide upon the exact surgical procedure which it is wisest to adopt. Von Mikulicz, Krönlein, and not a few other surgeons have spoken strongly upon the question of gastro-enterostomy, saying that this method should be adopted only in cases where stenosis, either at or near the pylorus, is caused, or in cases where stasis of food is marked. There can be no doubt that in such cases gastro-enterostomy is productive of the most remarkable benefit to the health and well-being of the patient. The weight increases, the appetite and the power of gratifying it return, and vomiting, often the most distressing and unceasing symptom, stops at once. But there can also be no doubt that in some instances, when the growth does not actually obstruct, by its bulk, the onward passage of food, a decided benefit results from the operation. The stomach is better and more quickly drained, and, as a rule, food can be taken more frequently and with greater comfort. In the majority of these cases, however, little or no benefit results from gastro-enterostomy. The position, therefore, may be thus briefly stated: If, after exploration, a growth is found to be obstructing the pylorus or to be narrowing the stomach and causing an hour-glass condition, or if stasis of food has been a marked symptom, then gastro-enterostomy will give very decided relief. If, on the other hand, the growth be confined to one or other

of the curvatures, and if neither stenosis nor stasis be present, gastro-enterostomy will give little or no relief: it will not prolong life nor give a greater degree of comfort.

I am entirely in agreement with the advice given by the man most competent to express it, W. J. Mayo, to the effect that gastrectomy may with great benefit be performed not only as a possibly curative operation, but also deliberately as a palliative operation when growths are present in inaccessible glands or in the liver.

The mortality of gastrectomy has been so much reduced by the perfection of the technique of the operation that the figures of Krönlein and Mikulicz, though they must still be quoted, do not represent the best practice of today. Gastrectomy does not now involve a greater immediate mortality than 10 per cent., and the relief to the patient from the removal of a noxious ulcerating mass in the stomach is very considerably greater than that which attends gastro-enterostomy alone.

The operation of gastrectomy in the hands of von Mikulicz and of Carle and Fantino has given a lower mortality than gastro-enterostomy. Its advantages as compared with gastro-enterostomy are that it gives a greater prolongation of life—ten or eleven months longer—and that it affords a greater degree of comfort to the patient. Though recurrence may follow, yet in the majority of cases the patient is relieved greatly by the removal of a foul, ulcerating growth, from the surface of which an offensive and septic discharge is constantly occurring, and from which hæmorrhages, more or less copious, are often likely to take place. If, after removal of a malignant growth of the stomach, the surgeon will open the viscus and inspect the surface of the tumour, he will realise, when he sees the foul, ulcerous mass, that its removal cannot but be of vast benefit to the patient. It is true that in the great majority of cases the growth will recur either locally or generally; but the question may arise as to whether gastrectomy should not be performed deliberately as a palliative operation in cases where an early

secondary deposit can be seen in the liver, or inaccessible or irremovable glands be found in the pancreas or along the aorta and vena cava. If we take into account the following advantages of gastrectomy as compared with gastro-enterostomy—that in the most competent hands its mortality is not greater, but is even less, than the mortality of gastro-enterostomy; that a prolongation of life for ten months longer than the period given by gastro-enterostomy is the rule; that the comfort, the general health, appetite, and well-being of the patient are all emphatically better; and, finally, that the patient has always a chance, even though it is of the slenderest, of a complete recovery from his disease—if we take all these into our consideration, there can be no doubt that the operation of choice will always be gastrectomy. Gastrectomy will be done always when a radical operation is attempted: it will probably be done often when nothing more than a palliative operation is intended.

If, after the abdomen has been opened, it is found impossible or imprudent to attempt either gastro-enterostomy or gastrectomy, some relief may be obtained by performing duodenostomy or jejunostomy. The scope of these procedures is very strictly limited; but in rare instances, when the prolongation of life for even two or three weeks is of the greatest importance, then either of these operations can be done with propriety. The operations are simple, speedily done, and cause little or no shock, and they can, if need be, be readily performed with cocaine anæsthesia.

In Mural Cancer.—In these cases obstruction may be absent. Diagnosis is, therefore, not so early, so that when the abdomen is opened a large area of stomach may already be affected. Even if no narrowing is produced, a gastro-enterostomy, by determining rest, will assuage pain and lessen the rate of growth. A complete local removal, however, is the ideal for whose attainment we should strive.

The extent of such removal will vary from the minimum of an hour-glass stomach to the maximum of a general infiltration

of both walls. The surgeon will be guided in a decision by the extent of such growth and by his personal capacity and preference. It is, I think, possibly open to question whether a complete gastrectomy is a scientific operation or a brilliant exploit in surgical gymnastics. The records of the cases so far performed are certainly far better than could have been anticipated—one case of my own did very well (see next chapter).

In all cases of local excision, whether in the body of the stomach or at the pylorus, a wide healthy area surrounding the growth should be removed. Experience goes forcibly to shew that it is from local recurrence that patients die, even when the incisions have been made, as it would seem, wide of the disease. The direction of the spread of the growth should be carefully noticed. If the growth is spreading circularly in the line of the vessels, it shews little tendency to recur after removal; if it is spreading transversely along the curvatures, there is said to be a strong tendency to recurrence (Mayo). The importance of Cunéo's observations, already referred to, may be again emphasised.

In Growth at the Cardiac End.—Only palliative operations are possible when the growth involves the cardiac orifice and the adjacent portion of the stomach. Levy has, indeed, planned an operation—and practised it upon the cadaver—for the purpose of removing such a growth ("Langenbeck's Archiv," 1898), but, so far as we know, a procedure of this kind has only once been attempted during life. This was by Mikulicz, who removed a primary carcinoma of the cardia and a portion of the œsophagus between 3 and 4 cm. in length. The operation was exceedingly difficult on account of spreading of the growth towards the pancreas and implication of the retroperitoneal lymphatic glands. The patient died of peritonitis. Mikulicz expresses the hope that not only carcinoma of the cardia, but even of the lower end of the œsophagus, may soon prove to be within the safe reach of a capable surgeon.

Krehl has shewn that in dogs the two pneumogastrics may be completely destroyed at the lower end of the œsophagus without interfering in any degree with the processes of digestion.

In all cases gastrostomy should be performed at the earliest moment after the diagnosis is assured.

CHAPTER XVII.

COMPLETE GASTRECTOMY.

THE following are the notes of a case in which I removed the whole stomach on account of its universal implication in a malignant growth.

The patient, a married man, aged forty-three years, who had been under the care of Dr. Peter Macdonald of Acomb, was admitted to the Leeds General Infirmary on May 24, 1907. He was the father of two healthy children and had always been healthy himself, the only illnesses which he could remember being influenza two or three times and an ischiorectal abscess some ten years previously to admission. He had always had as his occupation the management of horses and had been in his present situation as coachman for five years. He said that all his relatives, so far as he could remember, had died from "old age." He had been in good health up to two years ago when he gradually began "to go off his food." By this he meant that he did not want his food quite as he had been accustomed to do. He could eat anything but was afraid of the pain which he knew would come on after taking anything. This pain, which was relieved by food for an hour or so, was situated in the epigastrium and continued until he vomited, when it at once subsided until an hour after his next meal. The kind of food taken made no difference to the pain experienced. The vomiting commenced as a profuse gush, and in the vomit he recognised food which he had taken at his last meal. There was never to his knowledge any hæmatemesis. After the first six months he was free for some weeks from pain and vomiting, but at this time he was under medical supervision and was taking liquids chiefly; he had his stomach washed out every other day for two weeks and was away from work for eight weeks. The stomach contents at this time were analysed as there was a suspicion of cancer in the medical attendant's mind; but the analysis gave a normal result. After eight weeks he returned to work still taking fluids and feeling much better, but

every now and again he had attacks of vomiting and pain; he noticed that he began to feel the pain at shorter intervals after his food was taken, but he was still relieved by vomiting. All this time he was steadily losing weight, which had fallen from 11 stones 4 pounds to less than 9 stones. He had also noticed that the amount of fluid taken at any one period was much less than formerly, until last Christmas, when the amount was so diminished that he was only able to take three or four mouthfuls at a time before he experienced a feeling of discomfort and vomited.

Fig 122.—View of the stomach from the outside.

From that time to the time of his admission this diminution in amount continued.

On admission the patient was in fairly good condition, but he looked as though he had been a stouter man at some time, his skin was somewhat loose, his muscles were flabby, and his cheeks were a little hollowed. His weight was 8 stones 2 pounds. When he was given some fluid to drink he merely sipped it a mouthful at a time and had to wait a few seconds (about ten seconds) before the fluid "settled" -he gulped and strained his neck forward as though trying to get the liquid to pass an obstruction. After a few seconds he would appear comfortable and ready for

another mouthful. He still vomited occasionally—the vomit was not fermented or sour. He could not take any solid food at all with the exception of cheese, a few “nibbles” of which he enjoyed. He never had any desire for food; in all about from 30 to 40 ounces of fluid were taken daily.

Abdominal examination.—The abdomen looked thin and excavated; its anterior surface receded sharply from the raised costal margin. Palpation revealed nothing abnormal; the walls were rigid and nothing unusual could be felt through them. Two

Fig. 123 —The stomach laid open

very small doses of tartaric acid and bicarbonate of sodium were given separately. Instantly some foam gushed out of the mouth. On examining the abdomen a puffy swelling of about the size of a billiard ball was seen and felt in the left upper half of the epigastrium immediately below the costal margin. No other part of the stomach was distended, and the inflated portion was everywhere quite definitely circumscribed. The conclusion reached from this examination was that there was possibly an hour-glass stomach with a very small cardiac complement, and that this

was due to the cicatricial contraction of an ulcer on the lesser curvature close to the cardia. A stomach-tube was then passed. It went 17 inches quite readily, but not further than that. Only a small quantity of fluid could be introduced. A little over four ounces was the most that could be retained; when this had flowed into the stomach the patient began to complain of pain, great tightness and oppression, and was obviously greatly distressed. The fluid soon returned clear; on one occasion a little blood was seen. Bile was frequently seen in the washings. At one examination it was found that when a measured quantity of fluid was

Fig. 124.—Skiagram of the stomach filled with bismuth. X and X are placed opposite the cardiac and pyloric constrictions.

used for the washing only two-thirds of it was returned through the tube. On two subsequent occasions the stomach was inflated; on one the swelling at the cardiac end was again well seen; on another it could not be demonstrated. The following was the result of an examination of a test-meal. Macroscopic: Food badly digested; blood. Chemical: Blood; no free hydrochloric acid; no lactic acid. Microscopic: Yeast present; sarcinae present; bacillus geniculatus present and other organisms numerous; pus abundant.

The diagnosis was made of hour-glass stomach with a very small cardiac complement. Owing to the impossibility of in-

flating the distal or pyloric part of the stomach, reference was made, when the case was demonstrated to the ward-class, to the

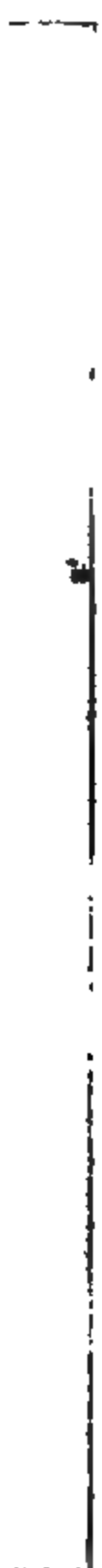


Fig. 125. --The stomach freed from both omenta and attached only by the œsophagus.

possibility of its being an example of "leather-bottle" stomach, the "linitis plastica" of Brinton.

Operation was advised and was performed on May 31st in the following manner: The abdomen was opened in the middle

Fig. 126.—A loop of the jejunum has been pulled upwards through an opening in the transverse mesocolon and a layer of sutures unites it to the œsophagus. The stomach is used as a tractor.

line by an incision which at first was about three inches in length, sufficient to allow of exploration, but which was increased subse-

quently to a length of eight inches. At the outset there was a very serious difficulty in exposing the stomach. The patient was a man who had been stout but who had lost weight rapidly; the anterior abdominal wall therefore shelved downwards from the elevated costal margin in such manner as to make the upper part of the stomach appear to be at great depth from the surface. The patient, moreover, was not at all comfortable under the anæsthetic and I had to wait a long time after opening the abdomen before I could proceed with the operation.

When the stomach was exposed it was seen to be small in size with walls of great thickness and solidity. The whole organ, indeed, felt solid, resembling a very large uterus, having thick walls and an insignificant cavity within it. (This is well shewn in the skiagraph subsequently taken.) The surface was smooth, white, and opaque; there were no adhesions and but few obviously enlarged glands along the curvatures. Towards the cardiac end the stomach was larger than elsewhere, so that the organ had something of the shape of a Florence flask; the larger part, however, was still very much smaller than the normal. This being the condition of the stomach it was at once evident that the performance of gastro-enterostomy was impossible, for there was no sufficient cavity in the stomach to admit of any anastomosis being made. The alternative procedures were complete gastrectomy and either jejunostomy or duodenostomy; after some deliberation I decided in favour of the former and I proceeded at once to remove the whole stomach. It was at this point that the abdominal incision was enlarged. Hot moist swabs in two layers were then packed into the abdomen in the usual manner to isolate the field of operation. The stomach was now depressed as far as possible by forcible traction by an assistant, and two long clips were applied to the coronary artery at its origin from the celiac axis. The artery was divided between the clips and its proximal end was ligatured. The upper and lower coronary groups of glands were detached downwards towards the stomach by gauze stripping and the cardiac end of the stomach was denuded by the same means. The gastrohepatic omentum was divided after ligature as close up to the liver as possible until the upper border of the pylorus was reached. Here, by gauze stripping, the pyloric artery and the gastroduodenal artery were exposed as they separately arose from the main hepatic trunk.

The pyloric artery was ligatured and divided and the finger was then passed downwards behind the pylorus and made to pre-

Fig. 127.—Lines of incision into œsophagus and jejunum.

sent at the lower border of the duodenum, where an opening was made in the great omentum. Through this opening the blade of a clamp was passed upwards behind the duodenum to present above

the pylorus. When this clamp was closed it lay about one inch beyond the pylorus and on the stomach side of it there lay the subpyloric group of glands. A second clamp with rubber-covered blades was now applied distal to it and the duodenum was cut between them. A single strong catgut suture was then passed through the proximal part of the duodenum and round the clamp to prevent the clamp from slipping away. The distal end of the duodenum was then closed by a continuous catgut suture, taking all the coats, and by a double layer of Pagenstecher thread suture above this. The clamp holding the proximal part of the duodenum was now covered with a gauze swab and was lifted well towards the left, exposing the gastroduodenal artery more conspicuously. The artery was ligatured and divided. Along the whole length of the greater curvature the gastrohepatic omentum was divided at a distance from the stomach of from 1 to 2 inches, so that all glands, including one or two dropped glands, were left attached to the stomach. The whole stomach was now free, for the gastrohepatic omentum had been entirely divided, the duodenum was severed, and the gastrocolic omentum ligatured and cut free. The whole stomach hung pendulous from the œsophagus. At this point the anæsthetist was asked to flex the patient's neck as much as possible, in the hope that this might enable the œsophagus to be pulled downwards a little more readily, and it seemed that this hope was fulfilled. The œsophagus was dragged upon with a fair degree of force until at least three-quarters of an inch of it was visible below the diaphragm.

The next step, and the most important and difficult of all, was the anastomosis of the œsophagus to the jejunum. The transverse mesocolon was already exposed on its upper surface in the wound; it was divided in an avascular area and the upper loop of the jejunum pulled through it. A point on this about eight inches from the duodenal-jejunal flexure was selected for the anastomosis. A piece of it about two and a half inches in length was laid transversely along a line immediately behind the œsophagus. As it lay there transversely, the right leaf posterior, its upper end was to the left, its lower to the right. The anastomosis was now begun by introducing eight light interrupted sutures between this portion of the jejunum and the œsophagus. The part of the circumference of the jejunum used was that on the surface which was now posterior and on this surface about

three-quarters of an inch from the mesenteric attachment. As the sutures were introduced into the œsophagus this was made to present and was well exposed by a forcible and continuous downward traction upon the stomach. The stomach, wrapped in a hot gauze swab, was used, and most efficiently used, as a retractor, or rather as an instrument of traction, upon the slightly dilated œsophagus. The help derived from this manœuvre was far greater than could be believed from a mere description. It converted what would have been an excessively difficult feat into

Fig. 128.—Suture of margins of openings in œsophagus and jejunum

one of comparatively easy accomplishment. Eight interrupted sutures then were introduced until the whole of the posterior half of the œsophagus was securely attached to the jejunum. In front of these a continuous suture was now introduced, exactly as in the operation of gastro-enterostomy from left to right; the needle carrying this suture was then laid aside to be presently resumed. The attachment of the œsophagus to the jejunum seemed now quite secure on this posterior aspect. In front of this continuous suture a small opening was made into the œsophagus and into the jejunum at the extreme left end of this attach-

ment. A continuous through-and-through Pagenstecher thread suture was now began and a few turns of the needle taken until the whole length of the small openings made had been united. These openings were then enlarged little by little from left to right, and as they were enlarged their cut edges were sutured by the same continuous stitch. This sequence of a small incision, a few stitches, slight enlargement of the incision, a few more stitches, was continued until the whole of the posterior part of the œsophagus was divided and sutured to the incision in the jejunum. Around the anterior wall of the œsophagus the same

Fig 129.—Suturing almost complete. The stomach still used as tractor.

sequence was continued, the stitch being now changed to the "loop on the mucosa" form. The result was that the stomach was retained as a tractor, drawing down the œsophagus until the last piece was severed, and at that moment the line of anastomosis was almost complete. Finally the outer continuous suture previously laid aside was resumed and continued round the anterior surface of the œsophagus and jejunum to its starting point where it was tied and cut short. The suture line was now complete. There were, it will be seen, eight interrupted posterior sutures, intended as anchor sutures, and the two continuous sutures, as in the usual operation of gastro-enterostomy. A few anterior

anchor sutures fixing the jejunum and the œsophagus to the diaphragm were now taken and the main part of the operation was now complete. The great omentum was turned upwards over the operation area and the abdomen closed.

The patient had borne the operation well. There had been no soiling of the operation field nor any exposure of viscera. As soon as the patient was put back to bed the continuous administration of saline fluid by the rectum was commenced. In the first twenty-four hours nine pints were taken; in the second twenty-four hours, six pints. After this it was discontinued. The help given by the absorption of 15 pints of normal saline solution within forty-eight hours is probably difficult to exaggerate. During this time, contrary to my usual practice, I gave no fluid by the mouth, but the patient was allowed to flush his mouth as often as he wished. He never complained of thirst and did not suffer any great amount of pain. He was kept lying flat on his back, with the head propped well forward. The administration of fluids by the mouth was begun very cautiously on the third day. Two teaspoonfuls of water were given every half-hour; on the fourth day this quantity was increased to two ounces every half hour. On the fifth day five ounces were given hourly; water and peptonised milk and albumin water were given in succession. On the sixth day two pints of these fluids were taken while the day nurse was on duty and one pint six ounces during the night. These quantities of the same fluids were slowly increased until on the tenth day five pints were taken in the twenty-four hours. On the eleventh day beef-tea and Benger's food were given, on the fourteenth day milk pudding, and on the eighteenth day bread and butter. During the third week the patient told us every day that he was hungry, a sensation which he had not experienced so keenly for two years. At the end of the third week he began to take meals of fair quantity consisting of minced chicken, milk puddings, etc. He was kept in bed for eighteen days, and on the twenty-second day was sent to a convalescent hospital. On leaving the hospital his weight was 8 stones 12 pounds, a gain of 10 pounds. On August 21st he weighed 10 stones and was able to eat all foods.

This is the second occasion upon which I have been called* upon to perform complete gastrectomy. The circumstances

* "Brit. Med. Jour.," 1903, vol. ii., p. 1498.

present in the two cases were similar; the stomach was small, with thickened walls and a cavity greatly reduced in size; it was invaded in every part by cancer, the glands were only slightly affected, there were few adhesions, no invasion of the parts around by the growth, and no secondary deposits. It has been computed by Fenwick* that 14 per cent. of all patients dying from carcinoma of the stomach shew no extension of the disease beyond the stomach. The type of cancer in both these patients was atrophic and the malignancy was probably of a low grade. It would seem that conditions of the kind enumerated are essential to the successful carrying out of the operation of complete gastrectomy. In my first case, which proved fatal, I adopted a technique which I thought satisfactory. After the operation I gave much thought to the details of the operation and endeavoured to construct a method which I should carry out if the opportunity again came to me. I had determined to make use of the stomach-tube passed through the œsophagus into the jejunum as a sort of cylinder upon which to suture, and I considered that the fixation (by a catgut suture) of the tube to the cut end of both œsophagus and jejunum (the suture being, of course, buried by the continuous sutures along the line of anastomosis) would help to make the feeding of the patient during the time of healing of the wound a simple and a safe matter. But when I came to perform this second operation I realised as I saw the stomach pendulous from the œsophagus that it might be used with the very greatest advantage to hold the œsophagus in a fixed position until my suture lines were practically complete. I feel sure that this point is one which has solved the greatest of all difficulties in the operation of complete gastrectomy, and it embodies, moreover, a technical principle which is applicable to other operations than this.

Pathological Report by Dr. Craven Moore.—The specimen includes the whole stomach and about a quarter of an inch each of the œsophagus and duodenum. The stomach is greatly diminished in size, its length being four and a quarter inches, and its maximum diameter in the region of the fundus two and a half inches. In form it is tubular, gradually contracting towards the pylorus, and about the middle third it presents several deep transverse folds which it is impossible to obliterate by tension; in con-

* "Cancer of Stomach," p. 54.

sistency it is firm and elastic. Attached to the stomach are portions of the gastro-hepatic and the gastro-colic omenta, and in the former are several lymphatic glands which are firm and of normal size; the omenta themselves appear quite normal. The serous coat of the stomach over the fundus and middle third of the organ appears somewhat thickened and more opaque, and here and there presents small white nodules about a pin's head in

Fig. 130.—Post-mortem appearances three years and nine months later.

size. The wall of the stomach is greatly thickened and indurated, the thickening being greater in the proximal two-thirds of the organ, where it measures half an inch, than in the pyloric portion, where it measures a quarter of an inch. The cut surface of the wall shews a mucous layer rather thinner than normal lying on a much thickened, greyish-white, dense submucous coat, a well-developed muscular coat in which the individual fasciculi are rendered more than usually evident in many places by an in-

crease in the intermuscular connective tissue, and a subserous and a serous coat which also appear to be slightly thickened.

It is very obvious that the great thickness of the stomach wall is the result chiefly of the increased extent of the submucous coat. The cavity of the organ, greatly diminished in extent, is divided into two distinct loculi by a zone of contraction situated in the middle region of the stomach, where the cavity is reduced to a narrow passage a quarter of an inch in diameter; this zone of contraction corresponds to the deep folds marking the external surface of the organ. The cardiac loculus corresponding to the fundus has a diameter of one and a quarter inches; it is rounded in form and its mucous lining has a mammillated appearance. The pyloric loculus, of more tubular form, is divisible into two portions by the character of its mucosa: in the proximal portion, corresponding to the middle third of the stomach, the mucous lining is smooth and thinner than normal; in the distal portion, which apparently corresponds to the pyloric antrum, the mucous lining is of normal thickness and is thrown into a series of irregular folds; it is in this portion of the organ that the submucous coat shews the least change. The two orifices of the stomach shew no indications of contraction and the stomach wall is here of normal thickness.

Microscopical Examination.—Sections of the wall of the cardiac loculus shew a thin mucous layer in which only the deeper parts of the tubules are present, and these present extensive and irregular proliferation of their cells, strands of which can be traced down into the underlying submucosa; between these proliferous elements, and in which they appear to be embedded, there is granulation tissue. The submucous coat consists of a dense white fibrous tissue in which the fasciculi of fibrils are well defined, run more or less parallel, have a wavy oblique course, and resemble very closely the fibrous elements seen in dense fibromata and in the atrophic variety of scirrhus carcinomata. Towards the mucous layer this coat is sharply defined; on the other side it penetrates the muscular coat by a series of strands running between the muscular bundles. This dense fibrous tissue shews a great paucity in cells, but in its innermost layers it shews here and there small collections and strands of epithelial cells, many of which can be seen to be directly continuous with similar cells in the mucosa; and in the remainder of its extent, even where it

penetrates between the bundles of the muscular coat, there are to be seen isolated strands and small islands of similar cells between the white fibres, the latter in particular being commonly adjacent to some blood-vessel and accompanied by a number of leukocytes. The blood-vessels are few in number and shew some thickening of their external coats but no obvious change in their middle or internal coats. The muscular coat does not appear to be increased in thickness; the muscular bundles are separated by strands of dense fibrous tissue penetrating it from the submucosa, which become more and more attenuated in the outer layers and so disappear; the muscle cells here and there shew indications of hyaline transformation but otherwise are normal. The subserous coat is slightly thickened and very occasionally one sees a few epithelial-like cells. The serosa appeared normal. Sections taken from the zone of contraction present similar changes, the mucosa is even thinner, and the folding of the stomach wall is seen to be due to contraction of the fibrous submucosa. Sections from the pyloric portion present appearances very little removed from those of the normal organ. Sections of the lymphatic glands from the gastro-hepatic omentum shew here and there small collections of cells, very similar to those described in the submucous coat, situated in the trabeculae and in the perivascular lymphatics.

Attempting to interpret these appearances there can be no doubt that we have to do with an extensive fibrous hyperplasia commencing in, and chiefly limited to, the submucous coat and involving that coat almost exclusively in its proximal two-thirds, a condition which so far corresponds with Brinton's conception of plastic linitis. The presence of the scanty proliferous epithelial elements in the remains of the mucosa and in the midst of the new formed fibrous tissue of the submucosa demonstrates that the lesion is not merely an inflammatory one in this case but that it is essentially a neoplastic change of a particular type which has its analogue in the so-called atrophic scirrhus met with in the mammary gland.

The patient made a good recovery from the operation. He was shewn at a meeting of the Section of Surgery of the Royal Society of Medicine on December 19, 1907; and in July, 1910, he was seen and examined by the members of the American Society of Clinical Surgery who were then in Leeds. He died on

January 31, 1911. During the three years and eight months that he lived after the operation he was under the constant observation and the occasional care of Dr. Geoffrey Thompson, of Scarborough, who has kindly given me very full details of his progress.

The patient was perfectly well up to the early part of the year 1910, when he began to shew the evidences of a profound anæmia. He was strikingly pale and breathless, and he lost weight. Under treatment, however, he improved, and in May, 1910, his colour had returned and he was able to ride and drive and attend to matters on the farm. In August, 1910, he began to fail again; he became easily tired, though he still tried to carry out the greater part of his work. His appetite remained good and he had no indigestion. In October the signs of anæmia re-appeared, he grew much weaker, and had to cease work. He began again to lose weight, his appetite vanished, and he occasionally vomited. There were no abnormal physical signs of any kind in the chest or abdomen throughout the illness. Soon after Christmas, 1910, he had to take to his bed, and he died on the last day of January, 1911.

I saw the man myself on many occasions. He expressed himself as feeling well and vigorous, and he had gained 2 stones 10 pounds after the operation, and he held the gain for nearly three years. His appetite was good, he experienced the sensation of hunger, and he was able to eat the ordinary foods; but he had to take a rather longer time over a meal than in the days preceding his original illness.

The post-mortem examination for which Dr. Geoffrey Thompson had arranged was made on February 1, 1911, by Dr. M. J. Stewart, and his report is as follows: "The body is that of a somewhat emaciated man. All the tissues and organs exhibit an extreme degree of anæmia and the blood within the heart and great vessels is very watery in appearance. On opening the abdomen, the peritoneum is found to be free from disease, although there are some old fibrous adhesions between the first part of the jejunum and the operation cicatrix in the anterior abdominal wall, as also between the liver and the diaphragm. The cardiac end of the œsophagus is anastomosed to a loop of jejunum, which, for this purpose, has been brought through the transverse mesocolon. The proximal portion of jejunum and the duodenum, which

ends in a cul-de-sac underneath the liver, appear to retain pretty much their normal dimensions, but at the seat of anastomosis and for a short distance beyond it, the jejunum appears to be slightly dilated. The whole intestinal tract, however, exhibits a marked degree of gaseous distension, and in the large intestine there are very numerous scybalous masses of considerable size. The liver is pale and somewhat fatty; the gall-bladder normal. The spleen contains a large and very old infarct, which occupies nearly the middle third of the organ. The kidneys are extremely pale and anæmic, while the capsules strip readily. The suprarenas are normal. There is no evidence of malignant disease in any part of the abdomen. A few of the retro-peritoneal glands are enlarged, but on microscopical examination they are found to be quite simple. The heart muscle is very pale and flabby. The valves are normal. The aorta and coronary arteries are quite healthy. There are numerous old adhesions on both sides of the chest. The lungs are extremely oedematous; they contain only a minimum of carbonaceous pigment. Microscopically the kidneys shew well-marked though early fibrosis, involving both the interstitial tissue and the glomeruli. The chief points of interest are: (1) Complete absence of any recurrence or dissemination; (2) the very profound anæmia; and (3) absence of any striking jejunal dilatation at or near the site of anastomosis."

The photograph of the specimen brought to Leeds was taken in my laboratory. It shews well the anastomosis between the œsophagus and the jejunum, the slight dilatation of the jejunum, the blind rounded end of the duodenum, and the absence of any secondary growths.

CHAPTER XVII.

GASTROSTOMY.

THE operation of gastrostomy consists in the making of an opening directly into the stomach, in cases of obstruction of the œsophagus or cardiac end of the stomach, for the purpose of introducing food directly into the interior of this organ. In the earlier cases it was found that the new orifice was not only an inlet, but also an outlet; that it permitted the free escape of food and gastric juice, and that, as a result of this, the skin around the opening became reddened and digested. The condition of the patients was often one of the most intense misery. The skin for four or five inches around the new orifice was intensely red, raw, and excoriated; it was excessively tender and sensitive, and the escape on to it of the acid gastric juice gave rise to the most intolerable smarting and burning pain. Measures were, therefore, devised for the purpose of making a valvular opening—an opening, that is, that would permit the introduction of fluids into the stomach, while it prevented the escape of gastric juice or digesting food.

A large number of operations have been described, and practised with success, and the surgeon now has the choice of several methods, any one of which will serve his purpose fully.

In the great majority of instances the cause which determines the necessity for the operation of gastrostomy is malignant disease of the œsophagus. Simple or syphilitic stricture of the pharynx or œsophagus or malignant disease of the cardiac end of the stomach may also call for the performance of this operation. In cases of malignant disease of the œsophagus it is important that the most suitable time should be selected for the performance of the operation. It was formerly almost always the case that the surgeon was asked to operate when the patient was in the

last extremity of his illness, when he was unable to take any food, or, at the most, only a few ounces daily, and when his condition was so bad that the danger of the operation—in itself a perfectly simple matter—had become considerable. If a patient is first seen when in this deplorable state, it is most desirable that all means should be taken to improve his condition before the operation is undertaken. It will sometimes be found possible, though often perhaps difficult, to pass a small silk catheter through the stricture into the stomach. If this can be done, the catheter should be left in, its outer end being secured by a tape and strapping to the ear, the forehead, or the neck. Through the catheter several pints of nourishing fluids can be poured daily, to the evident improvement of the patient's condition. During a week, several pounds in weight may be gained and the fitness of the patient to bear the operation be greatly strengthened. In one patient who was almost starved to death I was able to keep a tube in for six weeks; during this time she gained 21 pounds in weight. Had I performed gastrostomy at first, the result would almost certainly have been fatal; as it was, the operation was borne without the slightest shock.

In all bad cases, therefore, feeding through an œsophageal catheter should be attempted before gastrostomy is performed.

It is important not to delay too long in the advocacy of operation. It is equally important not to be precipitate. The operation, though of the greatest benefit to many patients, is nothing more than a forlorn and final measure of relief to prevent starvation; to many, it must be acknowledged, it has something revolting in its methods. When a patient can take enough fluid food by the mouth to keep himself alive and in fair condition he is not a suitable subject for gastrostomy. Early operation and late operation are both to be condemned. The proper time for operation is when the patient is ceasing to be able to take enough fluid nourishment to keep up his weight and strength, and it is, therefore, before he has lost of both so much that his power of resistance to surgical treatment is greatly reduced.

The operation can be done quite easily in a few minutes under cocaine anæsthesia, but I prefer to give a general anæsthetic if it can safely be administered. The usual preparation of the skin is made. Owing to the great wasting of the patient, the abdominal wall shelves away steeply from the costal margin; the incision is made, therefore, through an abdominal wall which is more nearly vertical than horizontal.

A great variety of incisions have been suggested. Some are vertical and pass through the rectus, or the rectus is bodily pulled aside; others are in varying degrees of obliquity. The valvular action of the stomach at the new opening is effected in several ways. In my opinion the operations which are the most satisfactory are the following:

1. Senn's operation (E. J. Senn).
2. Kader's operation.
3. Witzel's operation.
4. Frank's operation.

1. **Senn's Operation.**—This is the operation which I have used for the last five years. It is, in my judgment, the best operation for these reasons: it is simple, speedily performed, effects a perfect valvular opening, and does not involve, as do some of the methods, a sacrifice of some part of a stomach already reduced in size for the purpose of forming a cone which is pulled through an incision in the abdominal wall to lie beneath the skin.

The operation is performed in the following manner:

A vertical incision is made over the left rectus muscle near its outer border, commencing a little below the level of the tip of the xiphoid cartilage and continuing downwards for about $2\frac{1}{2}$ inches. The fibres of the rectus muscle are separated, not divided, and the peritoneal cavity is opened. If the separation is done with the finger covered by gauze, no nerves will be divided. The stomach is then sought and is easily recognised. It is said that the transverse colon has been mistaken for the stomach and has been opened; one would think that such a mishap is

impossible, for there is not the smallest resemblance between the two viscera. The stomach is generally found at once, but, owing to the fact that it is often thin-walled and shrunken from long suppression of its normal activity, it may lie flaccid and empty at the back of the stomach chamber, with the transverse colon in front of it. When the colon is displaced downwards, it comes at once into view. It is picked up, drawn forwards to the parietal incision, and a portion of it, as far removed

Fig. 131.—Gastrostomy (Senn's method). The stomach is opened and the tube fixed with a single stitch.

Fig. 132.—Gastrostomy (Senn's method). The first purse-string suture.

as possible from the pylorus, is selected for the operation. A point about midway between the lesser and the greater curvature is chosen for the site of the opening into the stomach. At this point a small incision is made with a scalpel of sufficient size to admit a No. 10 or 12 Jaques catheter or a piece of drainage-tube of about the same diameter. The catheter or tube is passed into the stomach through this opening for a distance of two to three inches, and is then fixed by a single catgut stitch which passes through all the coats of the stomach, at the edge

of the incision, and then picks up a portion of the tube. When this stitch is tightened, the tube is held fast and remains so held until the catgut is absorbed or cuts through—in about ten days.

The tube so fixed is now buried in an inverted cone formed from the walls of the stomach by the insertion of three purse-string sutures. The first purse-string suture is applied in a circle whose centre is the tube, and whose radius is about half an inch. The suture picks up the stomach-wall at about six points. As it is tightened, the tube is depressed into the stomach

Fig. 133.—Gastrostomy (Senn's method). The first purse-string suture tied.

Fig. 134.—Gastrostomy (Senn's method). The second purse-string suture.

by an assistant whose other hand holds the stomach steady, so that when tied, the suture closely embraces the tube. A second suture is now introduced at a distance of half an inch from the tube, picking up the stomach-wall at seven or eight points. As it is tightened and tied, the tube is again pushed inwards so that the suture again embraces the tube closely. A third, and, if necessary, a fourth, suture can be similarly introduced. The result is that a cone of the stomach is inverted into the cavity of the organ; and in the centre of this cone there lies

the tube or catheter closely embraced by the outer wall of the stomach. The stitches are all tightened with sufficient firmness to embrace, though not to constrict, the tube. When the last stitch has been cut short, two sutures are passed above and below the tube in order to fix the stomach to the parietal peritoneum. These sutures include the posterior sheath of the rectus and the parietal peritoneum on each side, and pick up a broad strip of the stomach about $\frac{3}{4}$ inch distant from the tube. They serve to draw the stomach up to the parietal incision and to fix it there firmly. The incision is now closed by suture in the usual manner; a continuous catgut stitch picks up the parietal peritoneum and

Fig. 135.—Gastrostomy (Senn's method). The purse-string sutures completed; fixation of the stomach to the anterior abdominal wall.

Fig. 136.—Gastrostomy (Senn's method). Shewing the invaginated cone and the line of the purse-string sutures.

the posterior sheath of the rectus, and, returning, picks up the

anterior sheath of rectus. Two stitches are used—one above and one below the tube. The skin is then sutured with silk-worm gut.

At the conclusion of the operation the patient is fed: about ten ounces of warm milk, with egg or brandy, are introduced through the tube into the stomach. At the outer end of the tube a second India-rubber tube is attached, a piece of glass tubing about one inch in length forming the medium of attachment. A glass funnel fits on the outer end of this second tube, and into it the food is poured.

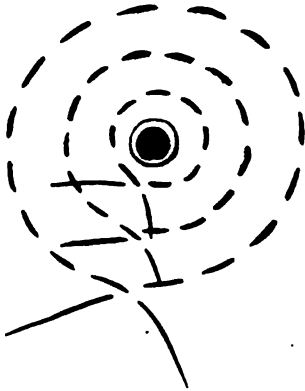


Fig. 137.—Gastrostomy (Senn's method). Diagram of the position around the tube of the purse-string sutures.

This method ensures an absolutely secure valvular opening. I have never known leakage to occur from the opening. At the end of ten or twelve days, rarely earlier, the tube will be found to be loose. It can then be removed and a second tube be introduced. It is better to keep a tube always in the opening, as, otherwise, there may soon be evidence of contraction, and the reintroduction of a tube may then be difficult.

A dressing is kept on the wound for the first fortnight, and is secured by an abdominal bandage. Through the dressing the tube passes, and its outer end is attached to the bandage by a safety-pin.

The condition of the patient may be so reduced that early and frequent feeding is necessary. The best food is warmed milk to which eggs or egg and brandy are added. Water should be given occasionally, and beef-tea or soups may afford a change. After a week or two of direct feeding the patient may find that he is again able to swallow thin fluids in small quantities. This

he should be encouraged to do, if no distress results, for the loss of the opportunity to *taste* food is often the most serious deprivation of which the patient complains. In some cases the patient may obtain satisfaction from masticating a little underdone beef, mutton, or some chicken or game, and feeding himself through the funnel or tube with the finely chewed food. If the patient will not, or cannot, use his mouth and teeth, great care must be exercised to keep them thoroughly clean. The teeth should be brushed three or four times daily, and the mouth well flushed with some fragrant mouth-wash.

Fig. 138.—Kader's method of gastrostomy: tube fixed by a single stitch, a fold on each side is raised up by a Lembert suture

Fig. 139.—Kader's method of gastrostomy: first layer of sutures tied, second layer in position.

2. **Kader's operation** consists in the vertical infolding of a portion of the stomach by interrupted sutures passed above and below a tube introduced through a small incision. The tube is first secured by a single catgut stitch, as in Senn's operation. Two vertical parallel folds of the stomach are then raised up on each side of the tube by four or six sutures. When these sutures, which include only the serous and muscular coats, are tied and cut short, a further series are introduced which pick

up the stomach-wall on each side of the original line of stitches. On tying this second row the first row of sutures is buried. A reference to Figs. 98 to 100 will make matters plain. The stomach is then fixed to the anterior abdominal wall, as in Senn's method. It will be seen that by this operation exactly the same kind of valve is produced as by Senn's procedure. The advantages of the latter over Kader's operation are that the operation is more speedy, that it is simpler, that fewer stitches



Fig 140.—Kader's method of gastrostomy: second layer tied, fixation sutures left long.

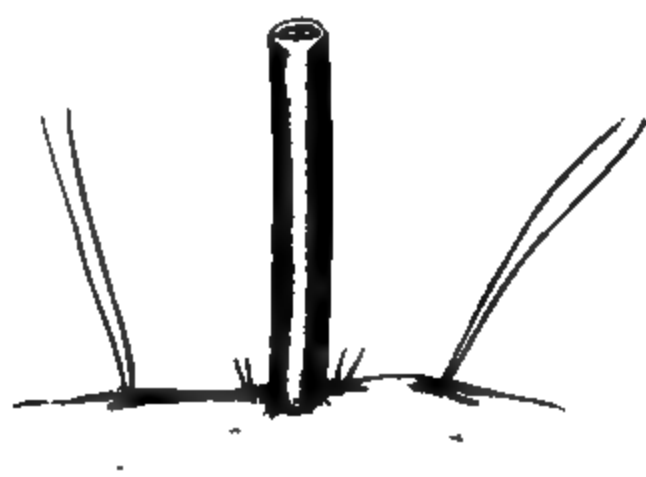


Fig 141 —Kader's method of gastrostomy: the parts seen in section.

are required, and that a cone, instead of a cube, is made to project into the cavity of the stomach.

3. **Witzel's Operation.**—In this operation the stomach is brought into the wound, and opened by a small incision into which a tube is fastened by a single catgut stitch, as in the two operations just described. The tube when thus secured is laid against the anterior wall of the stomach and is buried in a sort of trough or gutter formed by raising up a fold on each side of

the tube. The summits of the folds are brought together over the tube by interrupted sutures. One or two sutures are passed beyond the end of the tube, so as to be sure that the opening into the stomach is also walled off. About two inches of the tube are thus covered in and made to lie in a sort of canal in the stomach-wall. Witzel himself recommends that a second layer of sutures should be introduced, but this is quite unnecessary.

Fig. 142.—Gastrostomy (Witzel's method).

Marwedel has modified Witzel's method by passing the tube between the mucous and muscular coats for a couple of inches between the openings on the serous and mucous surfaces. There is no advantage in this.

Witzel's method proves most satisfactory in practice. Indeed, von Mikulicz, in an experience of 150 cases, is so satisfied with the results of both Kader's and Witzel's methods that he considers that there is no excuse for the introduction of more

complicated methods. I have used both and have found both to be good, but for the reasons I have already given I consider that Senn's operation is better than either.

4. **Frank's Operation.**—This operation has received a great amount of support from many operators. Though the results are good, they are no better than those seen after any of the

Fig 143 —Gastrostomy (Frank's method, as modified by Kocher). The whole of the rectus is pulled to the outer side.

preceding operations (indeed, leakage has been occasionally observed), and they are obtained only after a more prolonged and more complex operation.

An oblique incision, about $2\frac{1}{2}$ inches in length, is made parallel to the costal margin and about one inch from it, near the outer border of the rectus. The abdomen is opened, and

a cone of the stomach close to the cardiac end is then stitched, by four interrupted sutures or by a continuous suture, to the parietal peritoneum at the edge of the incision. A second incision is now made over the costal margin, about $\frac{3}{4}$ inch in length, at a distance of about one inch from the first incision. Between the two incisions the skin is undermined until the finger

Fig. 144.—Gastrostomy (Frank's method). The operation completed.

can be passed through the one opening, beneath a bridge of skin, and out of the other. Beneath this bridge of skin the cone of the stomach is passed until its apex projects like a nipple from the second opening. Here it is stitched or is held by a pair of hare-lip pins, which transfix it. The original wound is now completely closed by suture. The tip of the stomach cone may now be opened, and a catheter passed into

the stomach, or the opening may be deferred for twenty-four hours or more.

As von Mikulicz and others have shewn, the original obliquity of the passage does not long persist; the tube, after a time, passes directly backwards into the stomach. To prevent this, as far as possible, the second opening must be made well over the costal margin, whence it cannot be dragged down to lie in front of the posterior opening.

This operation cannot be easily performed when the stomach is very much shrunken from long-continued emptiness. It is, moreover, under any circumstances, wasteful in the amount of the stomach which is used up by the formation of the cone.

CHAPTER XVIII.

JEJUNOSTOMY.

JEJUNOSTOMY is an operation that can be but rarely called for. It is suitable only for those patients suffering from advanced malignant disease of the stomach in whom, owing to the position, extent, or character of the growth, gastro-enterostomy or gastrostomy is deemed imprudent or impossible.

Indications for Operation.—(1) Extensive infiltration of the stomach with carcinoma, when there is little or no healthy stomach-wall that can be utilised for the purpose of gastrostomy.

(2) General cicatricial contraction of the stomach, simple in character, dependent upon the swallowing of caustic fluids.

(3) Neumann has suggested that in cases of pronounced hyperchlorhydria jejunostomy should be performed in preference to gastro-enterostomy. He points out that the intensely acid secretion of the stomach, passing into the jejunum through the new opening, may produce ulceration, which will rapidly destroy the intestinal wall and lead to perforation—that is to say, a peptic ulcer of the jejunum results, in a manner precisely similar to that occurring when a peptic ulcer of the first portion of the duodenum develops. Peptic ulcer of the jejunum is recorded by Braun, Halm, Kausch, Körte, Steinthal, Hadra and Neumann, and others. In many cases the ulcer has caused death by perforation, and in all there was a great excess of free hydrochloric acid.

(4) Čäckovie and others have suggested that in cases of persistent hæmatemesis rest might be afforded to the stomach by an artificial mouth in the jejunum. This plan received the sanction and approval of Professor Mikulicz. It is also suitable in certain cases of chronic gastric ulcer where, owing to massive inflammatory adhesions between the stomach and the pancreas,

the ideal procedure—excision—cannot be performed. In these cases gastro-enterostomy, either the anterior operation with a lateral antero-anastomosis or the modified Roux operation in Y, is the routine. In many cases these large chronic ulcers, sur-

Fig 145 Jejunostomy (Maydl's method).

rounded by a mass of inflammatory tissue, do not heal after an anastomosis. In such cases jejunostomy combined with the modified Roux operation affords complete physiological rest for the stomach, and promotes the healing of the ulcer.

Several methods for the easy performance of the operation have been suggested. Only three are of value. The first was suggested by Maydl; the second is the modification of Witzel's operation, which I was the first to suggest; the third is Mayo Robson's method.

Maydl's Operation.—In this operation the abdomen is opened by a small incision through the left rectus muscle, and the upper end of the jejunum is sought. The bowel is cut completely

Fig. 146.—Jejunostomy (adaptation of Witzel's method as used by the author).

across, and the proximal cut end is implanted into the side of the distal, a few inches from its divided end. The distal open end is then stitched to the abdominal wall. The figure (Fig. 145) will explain the exact condition of things. The similarity of this method to that adopted in Roux's operation of gastro-enterostomy in Y is at once apparent.

Second Method. The following is the description of the method I carried out in my first case ("Brit. Med. Jour.," June, 1902):

The abdomen was opened a little to the left of and above the umbilicus, through the rectus muscle, whose fibres were split. The duodenojejunal junction was sought, the jejunum traced downwards for six or eight inches, and a loop drawn out of the abdomen. On the side of this loop farthest from the mesentery a small longitudinal incision was made, opening the bowel, and a piece of drainage-tube about the size of a No. 12 catheter was introduced, and fixed by a single catgut stitch, which included the cut edge of the bowel and the side of the tube. The tube was then laid along the bowel upwards towards the duodenojejunal flexure. A continuous stitch was now passed from side to side of the groove made by the tube, so that the tube, when the stitch was tightened, was buried by the overlapping of the edges of the groove. The stitch was begun about $\frac{1}{4}$ inch below the opening in the jejunum, so that any leakage there might be effectually prevented. About two inches of the tube were covered by the stitch, which was then tied and cut short. The line of suture in the bowel was then made fast to the anterior abdominal wall by a stitch at each extremity, and the abdominal incision was tightly closed around the tube, which projected for about ten inches.

When the patient is fed through such a tube, a funnel is fixed on to the end, and food poured in slowly. At the first only six ounces are introduced, but after the first few days up to a pint may be given in the space of ten minutes.

The opening in the jejunum is made, therefore, at approximately the point where Schlatter made the œsophago-intestinal anastomosis in his case of complete gastrectomy. It is clear from this case that enough food can be taken by the jejunum to enable weight to be gained and the general well-being of the patient to improve. If a jejunostomy were performed for any non-malignant condition of the stomach, the probability would be that, as in Schlatter's case, a decided increase in the capacity of the jejunum would be demonstrable, affording a reservoir for the food.

Mayo Robson's Method.—Mayo Robson has described (Trans. Roy. Med. Chir. Soc., 1905) a method of jejunostomy which depends upon the exclusion of a loop of intestine which is brought to the surface for the introduction of a tube. He writes:

“The operation I have performed, which I believe is new, consists in taking a loop of the beginning of the jejunum just suf-

Fig. 147.—Jejunostomy (Mayo Robson's method).

ficiently long to reach the surface without tension. The two arms of the loop are short-circuited about three or four inches from the surface, the short-circuiting being done either by means of sutures around a decalcified bone bobbin or by sutures alone. Personally I prefer the former.

“A small incision is then made into the top of the loop just

large enough to admit a No. 12 Jaques catheter, which is inserted and passed for three inches down the distal arm of the loop. This is fixed to the margin of the incision in the gut by a silk or a Pagenstecher suture, and the entrance of the tube into the bowel is further guarded by two purse-string sutures, one over the other. The top of the loop is fixed to the skin by one or two stitches and the wound closed. The patient can then be fed at once with some peptonised milk and brandy. The whole operation can be done in from fifteen to twenty minutes and with very little viscera exposure.

“Should the patient be too ill to bear the little extra time occupied by the short-circuiting, the tube may be inserted as directed and surrounded by two or three purse-string sutures, a proceeding which can be accomplished in a few minutes. In this case the loop of bowel must not be brought to the skin, but had better be fixed by sutures to the peritoneal margin and the aponeurosis, in order to leave part of the lumen of the attached loop within the abdomen for the direct passage outwards of the intestinal fluid with the bile and pancreatic secretion.”

The same variety of food may be given in jejunostomy as in gastrostomy; the staple article of diet should be peptonized milk. In some cases a duodenostomy may be preferred to gastrostomy. Hartmann has recently reported an example of duodenostomy for a cicatricial narrowing of the stomach following upon the swallowing of a caustic fluid. A duodenal mouth may be considered as more efficient than one opening into the jejunum, in that the food is introduced into the bowel at a point higher than the orifice of the ampulla of Vater. For the performance of this operation the second method above described is the most satisfactory.

CHAPTER XIX.

GUNSHOT WOUNDS OF THE STOMACH.

GUNSHOT wounds of the stomach vary greatly in character and in treatment, according to the nature of the weapon which produces them. In the South African War the rifles used by both the combatants delivered a bullet of small size, travelling with an extremely high velocity. The result was that there was a cleavage rather than an actual destruction of the tissues, and in those cases where a bullet traversed the abdominal cavity it was found that when the stomach or intestines were wounded, there was no leakage of the visceral contents, and that healing generally occurred without complication, especially in the case of a fasting man. It would appear that peristalsis comes to an end the instant the patient is struck, and the omentum, or a neighbouring coil of intestine, closes the minute line of cleavage, thus preventing faecal extravasation.

The lessons of this war, however, have no application in civil practice. The rude weapons of the suicide or the would-be murderer are often clumsy and uncertain. With them a larger bullet is used and the rate of velocity is very much less. There are, as a result, a large destruction of tissue and a crushing or bruising over a wide area. In addition to the perforation in a gunshot wound made by such a weapon there is a considerable amount of contusion and of rough damage to the immediately adjacent parts.

Sir Frederick Treves gave it as his opinion that it is inadvisable to operate in cases in which the abdomen is traversed above the umbilicus owing to the multiple character of the injuries; while the cases in which the abdomen is traversed below the umbilicus get well without operation.

Forgue and Jeanbrau ("Rev. de Chir.," September and Octo-

ber, 1903) have collected the notes of 112 cases of gunshot wound

of the stomach in which the lesion was verified either at the postmortem examination or at an operation. In 64 of these cases the ball passed completely through the stomach, wounding both surfaces. In some cases only one wall was injured, the ball remaining in the stomach, or passing, in one case, into the

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Fig. 148.—Relations of anterior wall of stomach (Testut).

intestine. In other cases the bullet had struck a curvature and clipped a piece away.

Seven of the cases died of hæmorrhage, which was due generally to the wounding of a large arterial trunk, such as the coronary. In one case, related by Guinard as having occurred at the Lariboisière Hospital, an abdominal exploration was undertaken in a patient who presented

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Fig. 149.—Relations of posterior wall of stomach (Testut).

no signs of injury except an abundant hæmatemesis. A very minute examination of the stomach was made, but nothing abnormal was found. The patient died, and at the autopsy

the bullet was found free in the peritoneal cavity. It had not perforated any viscus, but on examining the interior of the stomach a wound of the mucosa close to the pylorus was found, of the size of a franc-piece. This was the source of the hæmorrhage.

Peritoneal infection depends upon the size of the wound and upon the state of repletion of the organ. If the stomach is full, and if vomiting occurs, the contents escape freely into the general cavity of the peritoneum.

Spontaneous recovery is possible. Socin records the case of a man who was shot in the abdomen. It was thought that the

Fig. 150.—The two preceding figures superimposed. The unshaded area shews the only part of the stomach which can be wounded without injury being done to other organs (Forgue and Jeanbrau).

stomach was wounded, but the patient recovered without operation. Five months later he died of a "medical illness." At the autopsy two wounds of the stomach soundly cicatrised were seen. Spontaneous healing such as this depends upon the emptiness of the stomach, the small size of the wound, and the plugging of the wound by omentum, or upon the formation of a gastric fistula, which permits the instant escape of contents to the exterior, as in the oft-quoted case of Alexis St. Martin and in others related by Baudens, Cannizaro, and T. Smith.

In all cases of revolver or pistol wound—indeed, it may be said, in all forms of gunshot wound—of the stomach in civil

practice, the abdomen should be opened with the utmost expedition. The records of the cases collected by Forgue and Jeanbrau shew that the mortality increases in direct proportion to the delay. The result of their enquiries is shewn by the following table:

WOUND OF THE STOMACH ALONE, WITHOUT OTHER VISCERA.

	RECOVERY.	DEATH.
(a) Intervention within six hours.....	9	4 cases.
(b) Intervention without mention of time.....	2	4 "

WOUND OF THE STOMACH, WITH OTHER VISCERA.

	RECOVERY.	DEATH.
(a) Intervention within six hours	13	16 cases.
(b) Intervention within six to twelve hours	2	11 "
(c) Intervention after twelve hours	2	11 "
(d) Intervention without mention of time	3	5 "

In examining the stomach the utmost care should be exercised. The figures given by Forgue and Jeanbrau shew that it is not unlikely that some other damage will be inflicted by a bullet which traverses the stomach. Search for such an injury must be made, and any wounds so found must be appropriately dealt with. So far as the wound in the stomach is concerned, the edges must be trimmed or turned in by suture.

DETAILS OF THE OPERATION.

The usual preliminaries having been observed, the abdomen is opened by a free incision in the middle line above the umbilicus. In certain cases—in those, for example, in which the stomach is wounded near the cardiac orifice—a very free exposure may be necessary, and the median incision alone may be inadequate. Auvray has advised that in such circumstances a second incision should be made from the upper end of the central one, downwards and to the left along the costal margin, which may, if necessary, be partly excised. In all my operations upon the stomach, including a complete gastrectomy, I have never found the need of anything more than a central incision.

The abdomen being opened, a general inspection of the parts is made. There may be much blood-stained fluid and perhaps the contents of the stomach or intestine in the peritoneum.

A rapid but efficient cleansing is then necessary. The stomach is then picked up with a piece of gauze, to ensure a firmer holding, and the whole of the anterior surface carefully and methodically inspected. A little bubbling of froth or the sizzling noise made by the escape of gas may be enough to direct attention to the wounded spot; or if a vessel of moderate size has been wounded, the continued escape of blood will direct attention to the point of injury.

If a wound on the anterior surface of the stomach be discovered, it should be closed at once by suture. As a rule, no excision of the edge of the rent is necessary, but if there be much contusion or fraying, then a free trimming away of the damaged wall may be necessary. If the opening be of sufficient size, it may be made use of for purposes of digital exploration or inspection before being sutured.

The wound is closed by a double layer of stitches, the inner including all the coats of the viscus, the outer only the serous and muscular coats.

The anterior surface having been made perfect, an examination of the posterior is necessary. This may be effected either by an opening through the gastrocolic omentum at the lower border of the stomach, as advised by Forgue and Jeanbrau, or by turning up the transverse colon and opening the transverse mesocolon.

There may or may not be a second opening of exit on the posterior surface, and such an opening may or may not be near, or opposed, to the anterior. The bullet which has injured the anterior wall may remain in the stomach, be vomited, be passed on into the duodenum, or may penetrate the posterior wall. The surgeon, however, cannot neglect to make the most scrupulous examination of the posterior wall, and if a rent be found therein, he must deal with it as with the anterior wound.

A search for other injuries must be made. It is remarkable how often they are overlooked. Forgue and Jeanbrau quote many cases where, at the postmortem examination, gross damages, overlooked at the operation, were laid bare. Bertram

records a case where the spleen and the left kidney were found injured; Briddon, one where four perforations of the small intestine were found; Gabzewicz, one where an injury to the colon was seen; and Poncet and others, examples of injury to the liver. The minutest search must be made despite the fact that, because of the patient's collapse from shock or hæmorrhage, a prolongation of the operation is not without its own danger.

In not a few recorded cases the movements of the surgeon are greatly hindered by the copious amount of blood-stained fluid in the general peritoneum. No sooner is the field of operation cleared than a slow oozing of blood or deeply blood-stained fluid causes further delay, by obscuring all things. Professor Forgue, in 1897, drew attention to a most important point, by suggesting that the patient should, in such circumstances, be placed in the semi-recumbent position at an angle of 45 degrees. The viscera fall away from the wound, and venous oozing is checked.

In some few instances the loss of substance caused by the blow of the bullet has been so great that when the wound is securely closed, a marked narrowing—in one case an obliteration at the pylorus—has been produced. It would be necessary, then, to perform gastro-enterostomy to afford an efficient outlet, or to use the rent at the pylorus for the purposes of a gastro-duodenostomy.

Closure of the perforation having been effected, the abdomen is cleansed by wiping or by lavage, and the abdominal wound is closed. Drainage may or may not be necessary. Forgue advises its unvaried adoption, for the reason that a bullet traversing the clothes and the abdominal wall is certain to carry infection with it. Karlinski performed experiments upon rabbits which were wrapped in garments made of military cloth. They were shot in the abdomen, and the abdomen opened and its contents subjected to the most minute examination. Fine fragments of cloth were found in the peritoneum. Drainage may be effected through the anterior incision or through posterior incisions specially made for the purpose.

SECTION III.

OPERATIONS UPON THE INTESTINES.

CHAPTER XX.

INTESTINAL LOCALISATION.

It would undoubtedly be a matter of great interest and importance to the surgeon to discover if there were any means of determining with accuracy the exact position in the intestine held by any selected loop. Much labour and patience have been expended upon this task, and though the results are not so satisfactory as could be wished, they have, nevertheless, afforded us some valuable information. It is to Mall ("Bulletin of the Johns Hopkins Hospital," 1898, vol. ix, p. 197) and to Monks (Trans. Amer. Surg. Assoc., 1903, p. 405) that we are indebted for the best work in this matter. There are certain inherent difficulties in the subject. The intestine, for example, may be of any length from fifteen to thirty feet; the position of all its parts is liable to some variation from time to time, owing to unequal filling, to the position of the individual, and so forth; and the changes which occur in the bowel itself and in the mesentery by which it is attached are not sharp and abrupt, but gradual throughout.

Mall, in his examination of the condition of the mesenteric loops in 41 bodies, found what he called a normal arrangement in 21 of them. The sweep of the mesentery, and therefore of the bowel which it attached, in this "normal" arrangement was as follows: first to the left, then upwards and to the right, then obliquely downwards and to the left iliac region, then into the pelvis, and finally up to the right in the ileocæcal region.

It is more than probable, however, that during health there is a constant journeying of the large and small intestine from one part of the abdomen to another, and that two loops of intestine which at one moment are in contact may, in a few seconds, be widely separated. This is shewn during operations for gunshot wounds. Thus in a case of bullet wound where the shot traversed the abdomen directly from front to back, a little in front of the left anterior superior spine of the ilium, the jejunum in four places, the transverse colon in two places, and the lower end of the sigmoid were wounded.

Monks found that in normal conditions the upper six feet or so of the intestine were generally confined to the left hypochondriac region, occupying a deep fossa there, under the ribs, in such a position that its coils would not usually be encountered through any of the ordinary abdominal incisions. The middle portion usually occupied the middle part of the abdomen, while the lower part of the intestine lay generally in the pelvis and in the right iliac fossa. He writes:

"In order roughly to indicate on the outside of the body the positions ordinarily occupied by the upper, middle, and lower thirds of the intestine, I have found that two straight lines running obliquely across the abdomen at the two ends of and at right angles with the line of the mesenteric root will divide the abdomen into three regions, each of which will contain in most bodies about one-third of the intestinal tube, the upper third being in the first region, the middle third in the second region, and the lower (or third) third in the third region, as shewn in the diagrams.

"It will thus be seen that an incision anywhere above the first line will probably disclose loops belonging to (or near) the upper third of the intestine, anywhere between the first and second lines, loops belonging to the middle third, and anywhere below the second line, loops belonging to the lower third. This appears to be a pretty good general rule in intestinal topography, to assist us in determining, while making our incision, what part of the bowel we are likely to meet with first. We should not forget, however, that there are occasional and marked exceptions to this rule."

Fig. 151.—Shewing approximately the line of the mesenteric root as traced on the abdominal wall (Monks).

Fig. 152. -- Shewing the two oblique lines (black) drawn at right angles to the two extremities of the line (dotted) of the mesenteric root. The upper, middle, and lower compartments here indicated contain in most cases the upper, middle, and lower thirds of the small intestine respectively (Monks).

When the small intestine is examined from end to end, it is found that it is funnel-shaped, and that the upper part of the jejunum is of greater diameter than the lower part of the ileum. This is, of course, well recognised clinically by the fact that the further a gall-stone travels down in the bowel the more likely it is to become impacted; that a stone which easily passes through the jejunum is arrested in the ileum. The diameter of the last three or four feet of the ileum shews little or no narrowing as a rule.

As the bowel narrows in this way its walls also become thinner. The upper part of the jejunum feels thick when rolled between the fingers, owing to the presence of large and numerous *valvulæ conniventæ*. The ileum is thin, and its walls are more supple. The last two feet, approximately, of the ileum again become thicker, and just above the ileocæcal valve the muscular tissue in the ileum shews a decided increase. The condition of the mesentery is exactly the opposite of this: the thinnest part is that which runs to the upper end of the jejunum; the thickest part is that which runs to the lower end of the ileum. The mesentery, therefore, becomes gradually thicker the lower down it lies. This increased thickness is largely due to the deposit of fat, at first in thin scattered islets, later in larger thick slabs between the leaves of the mesentery. The upper part of the mesentery is thin and translucent. Monks draws attention to a point of importance. He writes:

“If one raises a loop from the uppermost part of the intestine and holds it in such a position that the light will shine through the mesentery, one will notice, in that part of the mesentery close to the gut, little transparent spaces between the *vasa recta*. Some of these ‘lunettes,’ as I call them, are almost *always present opposite the upper part of the gut* even in the thickest mesenteries. I have found, as a rule, that they gradually grow smaller, become streaked with fat, and disappear at about the eighth foot. They may, however, in exceptional cases, persist to the end of the gut.”

Some idea of the position occupied by any loop drawn out by chance through an abdominal incision may be determined by pulling upon it until its mesentery is taut. The finger is then passed along the upper, right, side of the mesentery until the posterior abdominal wall is reached. The relation of the point reached to the line of the attachment of the mesentery will then be recognised. In this way, moreover, by passing the fingers on both sides of the mesentery, its upper right side will be distinguished from its lower left side, and, therefore, the direction in which the bowel is running is determined.

The arrangement of the vessels in the mesentery has been studied by Dwight and Monks. Dr. Monks writes:

“Opposite the upper part of the bowel the mesenteric vessels are distinctly larger than opposite any other part of it. These vessels grow smaller and smaller as we pass downward until the lower third of the gut is reached, where they remain about the same size as far as the ileocæcal valve. The arrangement of the mesenteric vessels has some features which intimately concern the subject in hand, and which I shall describe with some detail. Diagrammatically speaking, the main branches of the superior mesenteric artery unite with each other by means of loops, which are called, for convenience, ‘primary loops’; in some parts of the tube, ‘secondary loops’; and even occasionally ‘tertiary loops’ are superimposed upon these. From these loops little straight vessels—the vasa recta already referred to—run to the bowel, upon which they ramify, alternating, as a rule, as to the side of the intestine which they supply. The mesenteric veins are arranged in a manner somewhat similar to the arteries. Opposite the upper part of the bowel there are only primary loops. Occasionally a secondary loop appears, but it is small and insignificant as compared with the primary loops, which are large and quite regular. As we proceed down the bowel secondary loops become more numerous, larger, and approach nearer to the bowel than the primary loops in the upper part. As a rule, secondary loops become a prominent feature at about the fourth foot. As we continue farther downward the secondary loops (and, possibly, tertiary loops) become still more numerous and the primary loops smaller, the loops all the

Fig. 153.—A loop of intestine, the middle of which is exactly three feet from the end of the duodenum. The gut is of large size. The mesenteric loops are primary, and the vasa recta large, long, and regular in distribution. The translucent spaces (lunettes) between the vessels are extensive. Below, the mesentery is streaked with fat. The veins, which had a distribution similar to the arteries, are for simplicity omitted from this and from the subsequent drawings. The subject from which the specimen was taken was a male of forty years, with rather less than the usual amount of fat. The entire length of the intestine was twenty-three feet (Monks).

Fig. 154.—A loop of intestine at six feet. As compared with Fig. 153, the gut is somewhat smaller. The vascularity of the intestine and mesentery is less. Secondary loops are a prominent feature. The vasa recta are smaller. The lunettes are also present, but are not so large as in Fig. 153. The subject was a male of about thirty-five years, with an average amount of fat. The entire length of the intestine was twenty feet (Monks).

Fig. 155.—A loop of intestine at nine feet. The secondary loops are large; the vasa recta are somewhat irregular and shew branches. No lunettes are present, and the mesentery is streaked with fat, and is, therefore, somewhat opaque. The specimen was taken from the same subject which furnished Fig. 153 (Monks).

Fig. 156.—A loop of intestine at twelve feet. The vessels are smaller. The primary loops are lost in the fat, but secondary and even tertiary loops are visible. The vasa recta are shorter, more irregular, and branching. The specimen came from the same subject which furnished Figs. 153 and 155 (Monks).

Fig. 157. —A loop of intestine at seventeen feet. The mesentery is opaque, and small tabs of fat begin to appear along the mesenteric border of the gut. The vessels are represented by a somewhat complicated network, and are seen with difficulty in the thick fat of the mesentery. The specimen came from the subject which furnished Figs. 153, 155, and 156 (Monks).

Fig. 158.—A loop of intestine at twenty feet. The gut appears to be thick and large. The mesentery is quite fat and opaque, and large and numerous fat tabs are present. The vessels, which are complicated, are seen with difficulty, and are represented by mere grooves in the fat. The subject was a stout woman, and the entire length of the gut was twenty-one feet (Monks).

time getting nearer and nearer to the gut. Opposite the lower part of the gut the loops generally lose their characteristic appearance, and are represented by a complicated network. Opposite the upper part of the intestine the vasa recta are from *three to five centimetres* long, when the loop of small intestine to which they run is lifted up so as to put them gently on the stretch. They are straight, large, and regular, and rarely give off branches in the mesentery. In the lower third *they are very* short, being generally *less than one centimetre* in length. Here they are less straight, smaller, less regular, and have frequent branches in the mesentery."*

* For the figures which are here reproduced I am very greatly indebted to the courtesy of Dr. G. H. Monks.

CHAPTER XXI.
INTESTINAL SUTURE.

THERE are probably no pages in the history of surgery that are so grossly encumbered with the description of useless methods of work as those dealing with the subject of the suture of intestinal wounds. Of the methods which have been advocated, volumes might be written, and willing and patient authors have not been found wanting. It is true that there has been a constant and laudable striving after perfection, but the steps upon the road to success have been infinite in number, and they have not all been steps in a forward direction. Even at the present time this subject is not free from the incursions of the eager inventor, enthusiastic as to the claims of his newest contrivance, despite the fact that all mechanical aids to suture are unnecessary—in that one word may be summarised all that can be said of them. I do not venture to suggest that even yet any method has been advocated that will win universal acceptance. But of this there can be no question, that such a method, when established, will of necessity combine in the highest degree two essential principles—simplicity and safety. A method that is simple, and therefore readily learnt, applicable to all forms of anastomosis, speedy because of its simplicity, and safe because of all its attributes, is the only one that is destined to survive.

The following suture methods possess certain definite advantages which have caused them to be practised by a large number of surgeons—they are recognised, that is, as good methods.

Lembert's Suture.—This, which is the simplest of all interrupted stitches, is one that every surgeon finds it necessary to use on some occasion. The needle, bearing a suture of fine silk or thread, is passed transversely to the wound. It picks up,

on each side, all the coats except the mucosa, and is introduced about a quarter of an inch, or rather less, from, and emerges about a line from, the edge of the wound, on one side, then passes across the wound, to enter on the opposite side at a point just clear of the cut edge, there to pass in the wall of the gut in the same manner as on the opposite side. When the suture is tied, the edges of the wound are inverted and broad surfaces of peritoneum on each side of the wound are brought into contact. The individual sutures lie about $\frac{1}{8}$ inch from each other. In tying the stitches it is important to avoid drawing them over-tight, and thereby causing a risk of strangulation necrosis. A snug apposition of surface is all that is necessary to ensure a perfectly firm, water-tight junction. When this suture is continuous and not interrupted, it is known as Dupuytren's suture.

The width of the fold picked up on each side will vary according to the necessities of the case. If the wound be small and the bowel-wall healthy, so that sutures are well held, the fold need be but small and the inner row of needle

Fig. 159.—Lembert's suture.

punctures may be quite close to the edge of the wound. In other instances, as, for example, in the perforation of a duodenal or typhoid ulcer, a wider fold must be made, and greater care must be exercised in the introduction of the needle, since, owing to the thickened and stiffened wall of the gut, the needle will perhaps cut through, or the stitch will fail to hold when tightened.

Halsted's suture, or the mattress suture, is in reality so devised that each separate suture is the equivalent of a double

Lembert suture. The needle having passed from one side of the wound to the other is made to return, so that the two ends of the suture lie upon the same side of the wound. When the

stitch is tied, there is no risk of undue constriction of vessels, and the stitch is little likely to cut through. Broad peritoneal surfaces are brought into apposition. The importance of the inclusion within the suture of the submucosa was emphasised by Professor Halsted. It was claimed for this suture that it is so safe that a single row is all that is necessary; that the tissues are less constricted than they are by a Lembert's

Fig. 160.—Halsted's suture.

suture, and that the suture does not so readily tear out when submitted to tension.

Dupuytren's Suture.—This suture is similar to the Lembert suture, but is continuous, not interrupted. After the first suture

Fig. 161.—Dupuytren's continuous suture: a continuous Lembert's suture; it begins on the left.

is introduced it is tied, and the suture is then continued from side to side of the wound to the opposite end.

Cushing's Suture.—Hayward W. Cushing (Trans. Amer. Surg. Assoc., vol. xvii, 1899) has described a suture that is also continuous. The needle, on each occasion that it is introduced, is passed parallel to the edge of the wound, and not, as in the Lembert or Dupuytren suture, at right angles to it.

All the sutures above described are passed with the intention of including all coats of the bowel with the exception of the mucosa. The layer which it is of the chiefest importance to secure, in order that the suture may hold well, is the submucous coat. This, as shewn by S. D. Gross and Halsted, is of great strength and toughness, and will bear a considerable strain when the suture is tied.

The examination of specimens removed from patients upon



Fig. 162.—Cushing's right-angled continuous suture.

whom the Lembert suture has been used shews, without doubt, that the ideal passage of the suture is not always achieved. In not a few instances it is found that the suture at some point has passed into or through the mucosa. The fear that haunts the surgeon's mind is that if the suture should penetrate the mucosa, a track for the escape of infected contents from the lumen of the bowel is open to the peritoneal cavity. Theoretically the danger exists, but in practice it does not often prove serious, unless the perforation occurs at the point where a knot is tied, and then leakage is very likely to occur. In an interrupted suture, therefore, which perforates all the coats of the bowel, and in which the knot is tied on the serosa, there are the

elements of disaster. If, however, the interrupted suture is tied on the mucous side, it is found, as a matter of unvaried experience, that no leakage occurs, or rather that what drainage or "capillary attraction" is excited by the suture, is towards the lumen of the gut, and not towards the peritoneal cavity. It has been the aim, therefore, of many operators to devise a stitch which, passing through all the coats on both sides of the wound, may be tied in such manner that all the knots shall lie within the lumen of the gut. The advantages of such a stitch are obvious: a firm, accurate, and even hold is obtained upon the gut; the vessels in the cut edge of the gut are controlled when the stitch is made continuous, and a rapid introduction is easily accomplished.

The method which, among modern operations, was the pioneer of all those planning to effect union by through-and-through sutures, was suggested by Maunsell ("International Jour. of the Medical Sciences," vol. ciii, 1892, p. 245). The following is the description given by him:

"Having cut off the cancerous, gangrenous, or injured portion of the intestine, bring together both ends of the bowel with two temporary sutures passed through *all the coats* of the intestine. The long ends of these sutures are left intact. One is placed at the mesenteric attachment of the gut and the other (exactly opposite) at the most distant portion of the bowel from the mesentery.

"These temporary sutures are very important. They secure the complete peritoneal covering of the mesenteric attachment of both segments of the gut, help to maintain the proper relative position and accurate co-adaptation of the two cut ends, and facilitate their subsequent invagination through the opening made in the larger segment of gut.

"When enterectomy is performed for gangrene or injury, the lower or distal segment of the bowel is generally the largest; but where the operation is performed for stricture, cancer, or tumour pressing on or constricting the lumen of the gut, the upper or proximal portion is often much larger than the lower.

"If you examine the gut in a living animal, you will find

that the blood-vessels pass into it from the mesenteric attachment. These divide and subdivide until they are lost in an invisible anastomosis in that portion of the intestine more distant from the mesentery.

"I propose to make an opening here in the larger segment of the gut, through which the invaginated ends of the divided

Fig. 163.—Maunsell's operation.

bowel may be dragged by the long ends of the temporary sutures, and when they are accurately sewn together all around, they may be pulled back into their normal position.

Fig. 164.—Maunsell's operation.

"The edges of the longitudinal slit made in the bowel, which begins about an inch from its transverse section, should be well turned in and brought together with a continuous suture passed through the peritoneal and muscular coats only. It is a well-ascertained fact that a slight longitudinal contraction of

the lumen of the bowel does not interfere with its physiological functions.

"By this simple device the perfect union by suture of a complete transverse section of the bowel, with its circumferential peritoneal surfaces in exact position and all the knots of the sutures on the inside, can be accomplished.

"From an examination of the annexed figures it may be seen that the peritoneal surfaces are in accurate juxtaposition all around. While an assistant holds the ends of the temporary sutures, the surgeon passes a long, fine, straight needle, armed with a stout horse-hair or very fine silkworm-gut through both sides of the bowel, taking a good grip (quarter of an inch) of all the coats. The suture is then hooked up from the centre of the invaginated gut, divided, and tied on both sides. *In this*



Fig. 165.—Maunsell's operation.

way twenty sutures can be placed rapidly in position with ten passages of the needle. The temporary sutures are now cut off short, and the sutured ends of the bowel painted with Wölfler's mixture of alcohol, glycerin, and colophony, and blown over with iodoform—the same that he applies to the surface of the raw stump after removal of the tongue. The bowel is then pulled back. The longitudinal slit in the gut is well turned in and closed with a continuous suture and painted with Wölfler's mixture and iodoform powder."

In actual practice, therefore, Maunsell was content to rely upon a single row of sutures penetrating all the coats of the bowel. Many surgeons, however, being sceptical as to the security from leakage with one layer of stitches only, added an outer layer of Lembert sutures. One of the further ob-

jections to Maunsell's method was the possible formation of a diaphragm if an outer layer of Lembert sutures was used. In their experimental work, Edmunds and Ballance found that no diaphragm whatever was formed. Maunsell, by his work, shewed conclusively that a perfect suture-line resulted from the use of a single layer of stitches passing through all the coats. His method, however, in that it involved the making of a special longitudinal opening into the gut, was found to be unnecessarily tedious and complex, and efforts were, therefore, directed to such a modification of the method as would permit the principle to be retained while the steps to attain it were simplified.

Dr. Gregory Connell and Dr. Wiggin have both succeeded in perfecting a simple and effective method. Connell's method is, it seems to me, one of the most satisfactory methods of suture in use at the present time. It is easy to learn, simple, rapidly performed, and the line of union is firm and free from any chance of leakage. The only difficulty that could possibly be experienced in its use is that which arises at the time of tying the final stitch. A very little practice makes this easy. The following description is given by Dr. Gregory Connell in "American Medicine," vol. v, January, 1903, p. 135. I am greatly indebted to him for the excellent illustrations he has kindly sent to me, which are here reproduced.

"In using the interrupted suture, the first stitch should be taken at the mesenteric attachment. This stitch is of the greatest importance on account of the separation of the serous covering of the bowel at this point, and great care should be exercised in securing a perfect serous approximation at this point. In order to do this in the most satisfactory manner a stitch should be introduced as follows: The needle is made to enter the bowel-wall of one cut end from the lumen, perforate all coats, and pass through the serosa of one side of the triangular space formed by the separation of the serous coats; then on, over and through the serosa of the opposite cut end, at the same relative point, side of the triangular space, then

Fig. 166.—Connell's suture.



Fig. 167.—Connell's suture continued.

on through the wall into the lumen. This completes one-half of the stitch, and is made with one movement of the needle.

"The needle is next reversed, and a distance of about $\frac{1}{8}$ of an inch (3 mm.) is made to repeat the steps in the opposite direction—*i. e.*, entering the mucosa of the second cut end, passing through all coats of the bowel-wall, including the serosa of the triangular space, and then through the serosa of the triangular space of the first cut end, on through the wall into its lumen, where the needle end and the free end of the suture

Fig. 168.—Connell's suture continued.

are tied in a knot on the mucosa. This stitch, which acts similar to a brad, absolutely secures a perfect serous approximation at this point, which is considered by all to be the most difficult portion of an enterorrhaphy.

"The remainder of the union is closed by stitches exactly similar to this first stitch. The cut ends are held in proper position by any convenient means, such as the Lee holder, the Allis tenaculum forceps, or suspending loops of thread; but the best method in my experience is the plan of introducing

a stitch, such as are the other stitches, at a conveniently distant point, and leaving the ends of this stitch long, to be held by an assistant while the intervening stitches are being inserted.

"This method has the advantage of consuming no additional time, for when the union is completed up to this stitch and the long ends are of no farther use, they are cut away, leaving the stitch itself in place. This method, which I described in 1901, has been adopted by Dr. Wiggin in the description of his method published in 1902.

"With the ends thus held in proper position the introduction of the stitches is a very simple matter—merely one passage of the needle through all coats of both cut ends, and then at a distance of about $\frac{1}{8}$ of an inch (3 mm.) the same process in the opposite direction, and, finally, the tying of the knot upon the mucosa at one side of the seam.

"This is repeated till all but a small portion of the union is completed. Owing to the fact that it is impossible to place this last portion of the cut ends in the same relative position that we placed the first part—*i. e.*, seroserous apposition, it is therefore necessary, in order to introduce the same variety of suture, to proceed somewhat differently.

"In order to place the last stitch and knot in exactly the same relative position as the first ones, we proceed in this manner:

"The needle enters the gut-wall from the lumen, passes through all coats, and emerges from the serosa of one side. It is then made to cross over to the opposite wound margin, and, entering the serosa, passes through all the coats into the lumen of this side. The needle is then turned upon itself and made to retrace its steps at about $\frac{1}{8}$ of an inch (3 mm.) distant, passing from the lumen through all coats, emerging from the serosa; then over to the opposite side and entering through the serosa, and finally ending in the lumen of the cut end at which it began.

"Now the two ends of the thread which are to make the knot are side by side, emerging from the mucosa into the lumen, and then extending from the ununited part of the enterorrhaphy out of the body. The needle, in introducing this stitch, has passed through the cut ends in exactly the same order as it did when inserting the stitches in the earlier part of the operation when the cut ends were held in seroserous apposition—*i. e.*, mucosa, sub-

mucosa, muscularis, and serosa, then immediately on into the other end cut through the serosa, muscularis, submucosa, and the mucosa, and then this order repeated in the opposite direction $\frac{1}{8}$ of an inch (3 mm.) away.

"The needle and the free end of the suture now hang side by side from the mucosa, and in order that they be tied in a firm knot, proceed as follows:

"At a point in the line of union, about opposite this last and still untied stitch, a threaded needle is inserted, eye first,

Fig. 169.—Connell's suture continued.

between two of the previously inserted and tied stitches. The needle is passed between the apposed serous surfaces into the lumen.

"By passing the needle still farther onward it is made to present at the location of the last stitch, where the ends of the suture still protrude, and where the surfaces are not united. By slightly withdrawing the threaded needle a loop is formed with its thread; into this loop are placed the two free ends of the last stitch which is to be tied. By withdrawing the needle

Fig. 170.—Connell's suture continued

Fig. 171.—Connell's suture continued.

and in its loop the stitch ends, these ends will be made to present upon the peritoneal aspect of the bowel on the opposite side, between two of the previously inserted and tied stitches—*i. e.*, at the point where the threaded needle was inserted. Slight traction upon these ends will cause the remaining portion of the line of union to become inverted, and seroserous approximation will obtain entirely around the site of suture. Upon greater traction the bowel will become flattened, bringing the mucous membrane upon which the last knot is to be located into intimate relationship with the line of suture at the point where

Fig. 172.—Connell's suture continued.

the free ends protrude. The knot is tied with the bowel in this flattened position, thus avoiding the occurrence of any slack. While still retaining the tension and the flattened position, the ends of the knot are cut off short, so preventing any long free ends in the lumen. Upon allowing the bowel to assume its normal contour,—that of a cylinder,—the knot will slip between the already tied stitches into the lumen, and as it is attached to the mucosa of the opposite pole of the diameter of the gut, it goes with that portion of the bowel-wall."

The Connell stitch here described is, therefore, an interrupted stitch. In the same paper, however, Dr. Connell writes:

“As stated on previous occasions, either the interrupted or the continuous suture may be employed, the choice depending upon the teaching or the experience that the operator has had. This method may be applied equally well in circular enterorrhaphy, lateral anastomosis, pylorotomy, pyloroplasty, gastro-enterostomy, and in incised wounds of the intestine or stomach,—in fact, under any conditions where the ordinary sutures may be employed.”

Fig. 173. —Connell's suture continued.

Though interrupted sutures are, in certain stages of work, absolutely indispensable,—for example, in reinforcing at a weak spot or in securing a vessel in a cut edge of the gut,—yet I am convinced that the continuous suture is very decidedly to be preferred. The continuous suture is easily and rapidly introduced—very much more rapidly than the interrupted stitch. In the latter, the needle has to be received from an assistant, to be passed, the knot to be tied, and the ends to be cut for each separate stitch; such a series of separate movements necessarily involves a waste of time. The continuous

suture is tightened to exactly the right degree without any difficulty. It acts, when embracing all the coats, as a hæmostatic, making the separate ligation of bleeding points unnecessary. It produces, when used as a Dupuytren's suture, very accurate and equal apposition of serous surfaces along the entire length of the wound. It has never, in my hands, caused sloughing of the cut edges of the wound from constriction of the blood-supply, and I am, therefore, compelled to think that this fear, so often expressed, is but a legacy from an earlier age. The objections which have been raised to the continuous suture are—

(a) If one part of it becomes loose, the whole is liable to become insecure. When properly introduced, in the manner to be presently described, there is no fear whatever of any part of the suture working loose, nor, on the other hand, of any part of the suture causing puckering by being drawn overtight. An even tension all along the line is secured by unconscious effort after a little practice.

(b) If the bowel contract, the whole suture may become loosened and the wound gape. This might perhaps be true of a continuous serous stitch unsupported, but if a firm hold of all the coats is obtained, the fear of loosening is purely visionary.

(c) A considerable length of ligature material is left in the coats of the intestine. It has been shewn, as the result of experimental work and of observation upon man, that a stitch which perforates the mucosa will by degrees become loosened, and eventually pass entirely into the lumen of the gut. A stitch including the serous and muscular coats only will remain imbedded in the coats of the gut for months or years, but may also, probably because of a too deep penetration of the wall, eventually be discharged into the lumen. This, I believe, occurs in the very great majority of instances. On several occasions I have had the opportunity of examining an intestinal or gastro-intestinal anastomosis many months after the operation, and I have, in almost all, found that no trace of the original suture of silk or thread remained. The objection to the length of the suture cannot be upheld.

These supposed disadvantages of the continuous suture have no foundation in experience. It is true that the continuous suture can cause harm if improperly applied, but the same objection holds good to all forms of suture, and, indeed, to all surgical methods. The vice then is not in the suture, but in the wrongful application of it. It is perfectly easy to learn exactly how to introduce the stitch and the degree of tension that is the safest.

Of all methods of intestinal suture, it would seem to me that one is unquestionably the best for general use. It is the method in which two sutures, both continuous, are used. The inner suture includes all the coats, the outer, the serous, muscular, and subserous coats only. The inner stitch secures good and efficient approximation, a firm apposition, in fact, and acts perfectly in controlling the bleeding from the cut edge of the gut. The outer suture supports the inner and ensures a sufficient apposition of serous surfaces.

It might be feared that such a stitch would cause an inversion of the suture-line to a degree sufficient to give rise to a spur or diaphragm. In practice, however, it is found that the fear is not justified. The little thickening at the suture-line, though plainly seen within the first few days, gradually dwindles until a normal appearance remains.

This method of suture is applicable to all forms of intestinal anastomosis. I have used it in gastro-enterostomy, after intestinal resection in the small and large intestines, and after excision of the cæcum, both for lateral and for end-to-end anastomoses. Its universal applicability is, of course, greatly in its favour, for a surgeon can the more speedily complete a suture to which he is accustomed. It is simple and safe. I have used it in one part or another over 500 times, and the only occasion upon which the suture-line has leaked was in a case of end-to-end ileocolostomy, where a small fæcal fistula formed and remained open for about ten days. When the suture is completed, the accu-

rate apposition ensured by the inner suture prevents leakage until such time as a perfect serous union is completed.

The suture is applied in the following manner: The two openings, whether terminal or lateral, that are to be united are placed

Fig. 174.—Intestinal suture for end-to-end or lateral anastomosis. The cut ends are clamped and the outer seromuscular suture is commenced.

Fig. 175.—The seromuscular suture in its first portion is completed. The inner suture which embraces all the coats is begun. Note especially the manner in which the gap in the mesentery is secured. The needle enters at the point, A, and passes at the direction of the arrow.

side by side, the bowel in which they are, being held by a clamp. The outer or serous stitch is now commenced at the part of the gut farthest from the operator, and an ordinary Dupuytren's stitch is used, being continued around the posterior margin of the opening until the point nearest the operator is reached, when the

needle is laid aside. The needle, on each occasion that it is passed, picks up only the serous and muscular and in part the submucous coats. At least that is the intention of the operator, but I think it not at all unlikely that sometimes the needle may penetrate deeper than this, and include all the coats of the bowel. If this is done no harm comes from it.

The second inner stitch is now started. The needle is passed through all the walls of the gut, which lies to the operator's right, at the point of the bowel which is farthest from him. After passing from the mucous to the serous coat, it is withdrawn and then passed through the opposing gut from the serous surface to the mucous, and the suture is tied, so that this knot lies within the lumen of the bowel. If an end-to-end anastomosis is being performed, the first stitch is taken in the manner shewn in the annexed drawing. The end of the suture is left long and is held by a clip. The stitch is now passed along the hinder margins of the openings to be united, until the part of the gut nearest to the operator is reached. Half of the suture line is then completed.

Fig. 176.—The first portion of the inner suture is almost complete. This is the point at which the character of the stitch changes, as shewn in next illustration.

The suture now returns to the point from which it started along the anterior margin, picking up all the coats in the same manner until the original end of the suture is reached, when the stitch is knotted and cut short. If it is desired to infold the mucous membrane, which is better though not necessary, the anterior layer of this inner suture is passed in a different manner. The principle

to be then observed is to pass the needle twice consecutively through each side of the wound so as always to leave a loop on the mucous surface. On each wound edge the needle then passes from serous to mucous, and at once back from mucous to serous surface. As the stitch is drawn tight

Fig. 177 —The inner through-and-through suture is changed here. The needle having reached the mucous surface of the left opening is passed in on this side again from mucous to serous surface. Then on the right side it passes from serous to mucous and back from mucous to serous surfaces, so that a loop is always left on the mucosa.

Fig. 178.—The inner suture continued. Note the loops always on the mucosa. When the stitch is tightened the cut edge of the mucosa is infolded and serous apposition secured.

the mucosa becomes infolded. The character of the suture stitch, from the ordinary continuous running stitch to the "mucosa-loop" stitch, is changed when the first half of it is almost complete at the point shewn in the figure. The needle is introduced at points about $\frac{1}{10}$ or $\frac{1}{12}$ of an inch apart, and the stitch is tightened to the necessary

degree by holding it taut for the better demonstration of the next point for the introduction of the needle. When this stitch is complete, the clamps are generally removed. The outer serous stitch is now continued; the needle which was temporarily laid aside being

again picked up and the suture continued around the anterior margin of the first suture until the point is reached from which it started, when the suture is tied and cut short. The needle which it will be found most convenient to use is the ordinary curved intestinal needle; for suture material I prefer celluloid thread. The stitch is not interrupted or knotted at any point.

Fig 179.—The inner suture completed; the return half of the outer suture begun.

Such are the chief forms of intestinal suture, and by the help of these all forms

of intestinal repair or anastomosis can be safely accomplished. Of them all, I believe that the Connell stitch and the stitch just described, in which two layers of sutures are used, are those which possess undoubted advantages over all others. They are, in my opinion, the two sutures upon which surgeons of the present and of the immediate future will find it safest to depend. The use of mechanical appliances is no longer necessary; these have played their part—a most important part, I gratefully admit—in the development of surgical work, and it is now time that their use should be abandoned. They have been useful, nay, indispensable, steps on the march of progress. To Murphy, above all other surgeons,—for his instrument is one of the most ingenious mechanical contrivances ever invented,—we

should gratefully acknowledge the debt we owe. Without the knowledge that work with his button has given to us the surgery of the stomach and intestines would never have reached its present stage.

The weightiest argument against all mechanical aids to anastomosis is this—they are unnecessary. By their aid we do not accomplish anything that cannot be accomplished with equal rapidity and with greater safety by the simple suture. We have nothing

to gain from their use, and we risk much by leaving behind something which may be, and often has been, the direct cause

of danger and of death. The day of mechanical aids is over. The buttons and the bobbins, the elastic ligatures and the forceps of many forms, have now no more than an historical interest.

The method of end-to-end anastomosis by invagination has been perfected by C. L. Gibson. In certain circumstances the method offers advantages

over any other, and is especially applicable when the pelvic colon has to be united to the rectum. ("Trans. Amer. Surg. Assoc.," 1910, xxxviii, 262.)

Fig. 180.—The inner suture completed; the outer one (seromuscular) resumed.

Fig. 181.—The two sutures complete; the final knot ready for tying.

CHAPTER XXII.

ENTEROTOMY AND ENTEROSTOMY.

ENTEROTOMY.

By the term enterotomy is understood the opening of the intestine for the purpose of immediate drainage or for exploration, followed by the closure of the wound. Enterotomy is to be distinguished from enterostomy, in which the opening in the intestine is fixed to the abdominal wall in such manner as to ensure continuous drainage from the bowel.

The operation of enterotomy is most frequently practised in cases of acute intestinal obstruction. It is also, though rarely, necessary, in cases of polypus of the intestine, or for the removal of a foreign body, such as a gall-stone. Enterotomy should be looked upon as an almost essential feature in cases of acute intestinal obstruction. If the distension of the intestine above the obstruction is considerable or of comparatively long standing, the needed relief to the patient is not afforded by the mere act of freeing the constricted spot. The mechanical impediment to the onward flow of intestinal contents is not the cause of the serious condition of the patient. It is the overloading, distension, and the ulceration of the gut above the block, together with the absorption of contents whose bacterial virulence is greatly increased, which call for instant relief. No operation for acute obstruction can be considered complete which leaves an intestine, whose function it is to absorb, overdistended by contents of an offensive and poisonous nature. To empty the bowel of its fæculent contents is not to add a danger to the operation by reason of the opening and subsequent suture, but to remove, at the expense of a trifling expenditure of time, that condition which makes most speedily for failure.

In a case of acute obstruction the operation is performed in the following manner:

The abdomen is opened, the point of ensnaring located, and the gut made free. The details of this procedure will be subsequently considered. The bowel which had been constricted is brought up to the surface and examined. A point about ten inches above the site of the constriction is chosen for the incision. It is desirable not to select a point nearer than this, because of the probable damage to the bowel within the few inches immediately above the obstruction. A loop, having been drawn out of the abdomen, is temporarily emptied and clamped by the fingers of an assistant. A longitudinal incision about one inch in length is then made in the bowel at the part most distant from the mesentery. The edges of this incision are seized and

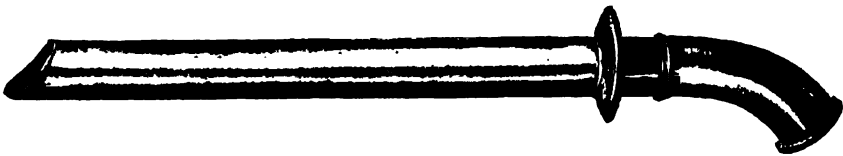


Fig. 182.—The author's tube for use in intestinal obstruction.

gently held with the finest French vulsella. The lower portion of the distended bowel—that between the site of the obstruction and the incision—is now emptied. Two fingers are placed one on each side of the intestine, and the contents are “milked” upwards and emptied through the incision, the lips of which are held apart by the vulsella. A glass tube (a Bantock's tube does very well) about six to eight inches in length, to the outer end of which a large drainage-tube is attached, is now gently introduced into the opening in the gut and pushed gradually upwards for three or four inches. The vulsella are now removed from the edges of the incision, and with a piece of gauze the bowel is drawn on the glass tube to within about an inch of the end to which the rubber tube is attached. At this point the bowel is held firm by an assistant, who wraps a piece of gauze, wrung out of hot sterile salt solution, around the tube and gut together.

Leakage by the side of the tube is in this way avoided. The surgeon now draws more and more of the intestine on to the tube, and as this is done, the bowel so drawn down empties its offensive contents through the rubber tube into a receptacle held for the purpose. It will be found that upon a tube 6 inches in length eight or ten feet of intestine can readily be drawn. This manœuvre must be carried out slowly and with great care. It is essential that the intestine shall be pulled on to the tube little by little. The tube itself must not be pushed into the bowel, but the bowel drawn over and along it. Time must be allowed for the perfect emptying of the bowel, and any damage to the

Fig. 183.—The bowel being pulled gently along the tube. The tube must not be pushed into the intestine.

bowel by the tube must be diligently avoided. When as much of the bowel as possible has been drawn on to the tube, the tube may be gradually withdrawn as the bowel, now collapsed, is replaced gently within the abdomen, or, if thought desirable, the bowel may be washed out with warm sterile salt solution. This is done by puncturing the bowel at the highest point reached with a medium-sized needle to which a long India-rubber tube and a funnel are affixed. As the salt solution runs into the bowel it gradually trickles downwards and escapes by the rubber tube. The glass tube is withdrawn slowly, and the fluid is "milked" downwards towards its outlet. If the fluid is found to be running upwards in the intestine instead of downwards, the part of

the gut immediately above the point of entrance of the needle is lightly closed with a Doyen's clamp. When the glass tube is almost withdrawn, the flow of saline solution is stopped. If necessary, one or two ounces of Epsom salts dissolved in water may be introduced through the needle and allowed to remain. The needle is now withdrawn, and the point of puncture closed by a few Lembert sutures which fold the intestinal wall transversely. The bowel is now replaced, with the exception of the loop in which the incision for the tube was made. This is carefully washed

Fig. 184.—To shew the position of the tube when as much of the tube as possible has been drained by it.

after the removal of the tube, and closed by a double line of sutures—one including all the coats, the outer picking up the serous and muscular coats only. Great care is expended upon these sutures, since they are being introduced into a gut already damaged by overdistension and perhaps by ulceration. A final cleansing of the loop is now made, and the whole bowel is replaced and the wound closed. If the bowel has suffered excessive damage from overlong distension, a point higher than ten inches from the constriction may be selected. On this, the operator must decide. It is essential to select a spot whose appearance and consistence are as little different from the normal as possible.

ENTEROSTOMY.

The operation of enterostomy consists in the fixing of the bowel to the abdominal wall and the opening of the bowel for the purpose of allowing an escape of its contents. Two forms of opening are made. In the one, the small intestine or the cæcum, as a rule, is opened for the purpose of temporary drainage, a *fæcal fistula* being made. In the other, the large intestine, as a rule, is opened for the purpose of permanent drainage, an *artificial anus* being made.

Temporary drainage of the intestine is generally adopted when, in cases of acute intestinal obstruction, the patient is in such peril that only the smallest possible interference can be tolerated. In circumstances such as these any search, however brief, however skilfully performed, would add a considerable danger to the operation. The purpose of the surgeon is then to give relief to the obstruction in the simplest manner, as speedily as possible, with the least possible disturbance of parts, leaving everything but the overloading of the intestine to be accomplished later. In some cases of obstruction, as Nélaton long ago pointed out, a mere relief from overdistension will permit a return to the normal. But such a fortunate event is of the greatest rarity, and it should, therefore, not be urged as a measure of persuasion to do an imperfect operation except in times of the greatest stress.

Enterostomy may also be performed at times with conspicuous success in cases of post-operative paralytic distension of the intestines where the patient is hastening to his end.

The operation of enterostomy, the formation of a fæcal fistula in the small intestine, is performed as follows: The skin being anæsthetised (a general anæsthetic is not necessary), the abdomen is opened by an incision about $2\frac{1}{2}$ inches in length in the right iliac region. This position of the incision is that originally advocated in 1840 by Nélaton, and it possesses many advantages. The first and chiefest is that if the cæcum be dis-

tended, it can be opened,—typhlotomy,—but if it be collapsed, a point in the ileum low down is likely, as shewn by Monks and others, to present itself in the wound. The advantage of having the opening in the bowel as low down as possible needs no emphasis. As soon as the abdomen is opened the cæcum or a distended coil of the bowel is seized and drawn gently outwards. The position and direction of the loop of gut selected should be changed as little as possible. The bowel is now

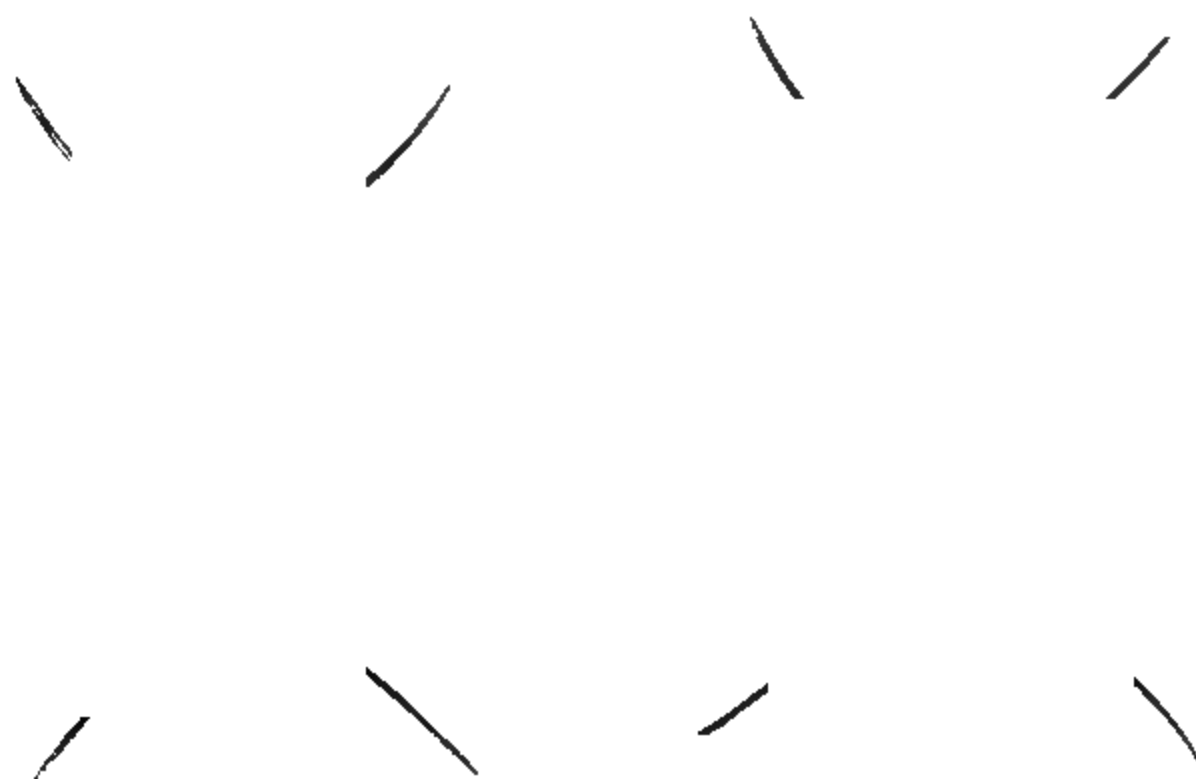


Fig. 185.—Enterostomy. Fæcal fistula—for drainage of intestine. The purse-string suture is tightened around a tube.

fixed to the parietal wound. Two sutures, one at each end, are first introduced. They pass through all the layers of the abdominal wound on one side, then pick up a broad piece of the serous and muscular coats of the intestine, and then pierce the opposite edge of the wound, passing through all the layers. These two sutures, one at each extremity of the portion of bowel to be fixed into the wound, secure a good attachment. They are left loose until a later stage. The peritoneal edges are now seized with two pairs of clips on each side, and a continuous

suture of fine Pagenstecher thread is introduced to unite the serous covering of the bowel to the parietal peritoneum and the muscle (or aponeurosis in the middle line) superficial to it. If the needle pass only through the peritoneum, it may tear, and a firmer hold is therefore desirable. It is most important, though sometimes difficult, to avoid a penetration of all the coats of the bowel when passing this suture. The skin should never be included. When this suture is completed, the through-and-through sutures are tied. The gut is now

ready to be opened, but it is desirable to postpone the opening, if it can be done with safety, for a few hours. A delay of even a couple of hours will ensure a fairly accurate sealing-off from the peritoneal cavity. From the inflamed peritoneum, lymph is rapidly poured out. When the bowel is opened, it is desirable to have some apparatus at hand wherewith to carry off the

Fig. 186.—Typhlotomy. The chief sutures in position.

profuse discharge. A Paul's tube to the outer end of which a large drainage-tube is attached is the most efficient of all. One of medium size will be found adequate. A somewhat similar tube, used in America, is known as "Mixer's" tube. Before opening the bowel a purse-string suture is applied around the spot at which the opening is to be made. When the tube is introduced, this suture is tied around the tube, and for the time prevents leakage. After two to five days, the suture works loose and the tube will be found to slip out. A second suture

can then be applied, which will act for a couple of days longer, and will thereby postpone the soiling and irritation of the surrounding skin. Around the tube sterile gauze is packed so as to keep it fairly steady, and this is changed from time to time as seems necessary. When the tube has finally worked loose and has been removed, the intestinal contents are discharged on to the surface. As a rule, it is not long before the skin shews signs of redness and excoriation, and finally an intensely red, angry-looking, eczematous condition results. If the opening be anywhere in the small intestine, the condition of the patient is lamentable and an early closure of the fistula is desirable. As each peristaltic wave reaches the opening there is a spurt of fæcal material or of intestinal juice, and the patient experiences a fresh accession of burning, almost intolerable pain. His condition, to say the truth, is one of abject misery. The only relief to be obtained in such circumstances is afforded by keeping the patient once or twice a day in a warm bath for an hour. The skin irritation can be to some extent prevented by a frequent cleansing and by painting over the skin a saturated solution of pure rubber in benzine. This should be applied from the first, and a protective coating thereby given to the abdominal wall. Despite all care, however, the soreness of the skin will almost inevitably occur.

It is, as I have said, important that the continuous suture fixing the gut should not include the skin. The fistula is the more likely to close spontaneously if the skin is not included. The gut is, in fact, stitched to the abdominal wall in much the same manner as the gall-bladder occasionally is in the operation of cholecystotomy, and in these cases, as in those, the fistula will shew a tendency to close. Closure of the gall-bladder is, however, a matter of certainty; closure of a fæcal fistula, performed in the manner described, is possible, though not frequent. In many instances the fistula has to be closed by operation in a manner to be presently described.

It is a matter of great importance that the opening should

be made into the intestine as low down as possible. The reasons for this are many. The high opening of the gut involves the risk of starvation. In those instances where the jejunum has been opened a speedy loss of weight follows, as might be anticipated. It is possible, in some such cases, to feed the patient by the fistula and so keep him alive or improve his condition, but an early closure of the fistula is, as a rule, imperative.

If the opening is made even three or four feet away from the cæcum, the bowel below the opening shews, as was pointed out by Lennander, the most remarkable tendency to contract adhesions. At a secondary operation for the closure of the fistula the separation of these intricate adhesions may be extremely difficult, and when the channel has been made complete, an intestinal obstruction may be caused by them. In one such case of my own a third operation had to be performed, and the gut at the site of the fæcal fistula joined, by lateral anastomosis, to the transverse colon. For these reasons, then,—the impossibility of recognising with the limited incision and with the necessary absence of handling the exact portion of the intestine which is seized, and the tendency to the formation of intricate and inseparable adhesions in the collapsed intestine below the fistula,—it is desirable to select for the opening, whenever possible, the cæcum rather than the small intestine. It is said that subsequent closure of a cæcal fistula is more difficult than in the case of an intestinal fistula. This has certainly not been my own experience; for in those cases of growth in the large intestine in which obstruction has been acute, the fæcal fistula has acted well, and when a later resection and end-to-end union of the colon have rendered the channel once more pervious, the fistula has often closed spontaneously or become materially reduced in size, so that an operation for its closure was of the simplest character. If the cæcum is found collapsed, the intestine must, of course, be opened, but, speaking generally, the opening of the cæcum is to be preferred to enterostomy.

In some cases the appendix may be brought up to the surface, fixed to the parietal peritoneum, and opened by cutting away the last half inch. A catheter may then be passed along the lumen of the appendix, and the cæcum can thereby be drained. When it is desired to close the opening, the wound can be reopened and the appendix be removed. This operation, first sug-

Fig. 187.—Appendicostomy. The incision in the skin is made long to shew the details of the operation. It need not be longer than 1 to 1½ inches when the operation is performed during life.

gested by Weir, of New York, is known as Appendicostomy ("Medical Record," August 9, 1902).

The operation of enterostomy, then, in certain cases, is undoubtedly a life-saving measure. In cases of advanced intestinal obstruction, when the bowel is overdistended and the patient's condition is bad, and in cases of so-called paralytic distension as-

sociated with septic peritonitis, due more often to appendicitis, a patient's life may undoubtedly be saved. But it is only for such exceptional cases that the operation should be reserved. It is true, as Nélaton claimed, that in a certain proportion of cases relief to the overdistension of the gut permits a readjustment of an entangled and obstructed gut, so that the normal condition is regained. Such an occurrence is, however, of the rarest and should never be expected. It is far more likely that even after relief to the overdistension the mechanical conditions of obstruction will persist and will lead to serious disaster. An ensnared loop will, for example, go on to gangrene, or perforation and extravasation will occur. Though recovery is possible, disaster is not improbably impending. The opening of the gut must, therefore, be considered only as a temporary expedient—to be avoided, if possible; to be resorted to only under the pressure of urgent necessity.

CHAPTER XXIII.

COLOTOMY.

THE discussions as to the advantages of inguinal over lumbar colotomy, or vice versâ, lose much of their interest and importance if two points be conceded by the advocates of both operations. These two points are:

1. That in all cases, wherever the incision may lie, the peritoneal cavity should be opened.

2. That in cases of acute obstruction demanding colotomy the old methods should be abandoned, and a Paul's tube be at once introduced into the bowel above the block.

The necessity for the observance of the first point will be generally admitted. With modern methods the opening of the peritoneal cavity for such a brief period as is needed for the performance of an inguinal colotomy is quite devoid of risk. The chief point in the former advocacy of lumbar colotomy depended upon the fact that the operation could be performed without opening the peritoneum, and, in days gone by, this statement carried great weight. The extraperitoneal operation, however, is most unsatisfactory, for when the colon is brought to the surface and opened on that side which is bare of peritoneum, a comparatively small opening is made, the opening shews a constant tendency to become narrowed, and, as there is no "spur" at the opening, there is an unhindered passage of fæces down towards the rectum. The lodgment of fæces, constantly increased in quantity, in the parts near the growth, teases the patient in many cases far more than all his other discomforts. Moreover, the necessity for an extraperitoneal opening being made belonged to an age of ruder surgery.

So far as the second point is concerned, it is only necessary to say that it is by the use of a Paul's tube, and by that only,

that it is possible for the bowel brought to the surface to be opened at once without risk of soiling the peritoneum. The old extraperitoneal lumbar colotomy derived its chief claim to consideration from the fact that the bowel could be opened instantly without any chance of peritonitis ensuing. In any form of colotomy, however, the peritoneum may now be freely opened and its soiling be securely prevented by the use of a Paul's tube. This subject is considered further in the articles dealing with enterostomy and with the treatment of intestinal obstruction due to growth in the large intestine.

For all these reasons the conclusion is reached that an intraperitoneal operation is always desirable. The only question, therefore, to be decided is as to whether an opening in the loin is a matter of greater convenience to the patient than one in the inguinal region. For many reasons, which will be readily understood, an opening at the side is less revolting than one on the anterior surface of the abdomen—it is out of the way, so to speak. But being so, it is more difficult to attend to if the patient has to rely upon himself for his toilet. An opening in front is readily cleansed and the dressings are easily changed.

From the anterior opening there is, as a rule, a greater tendency to prolapse of the bowel than from a lateral opening. But when the method to be presently described is adopted, the likelihood of prolapse to an extent causing discomfort is negligible.

Much has been written about the distress and misery caused to a patient by the existence of a colotomy opening. I believe that this is largely, if not solely, due to improper methods in the performance of the operation; to the extraperitoneal operation, with its absence of spur and consequent dribbling of fæces into the rectum; and to the prolapse from an inguinal opening. I do not find that, with the method to be described, there is any discomfort or distress whatever after the first two months—after the time, that is, that the patient has acquired

some control over the opening. I have recently written to eleven patients upon whom I performed colotomy followed by proctectomy at various times, all over six months ago. Ten of the patients expressed themselves as perfectly content, and all told me that they would decline any further operation to close the colotomy opening. The trouble caused by the opening was so slight that it was not worth while entertaining the idea of having even a trifling operation performed for the diverting of the fæces. One patient, though suffering no distress, said she would prefer to have an operation for the closure of the artificial anus.

In the following description of the operation of inguinal colotomy the steps which are followed after the abdomen has been opened belong equally to the lumbar operation, and, indeed, to colotomy wherever practised.

INGUINAL COLOTOMY.

When inguinal colotomy is performed the sigmoid flexure may be opened as high as possible or as low as possible. When opened as high as possible there is no fear of any prolapse, but there is little or no fæcal continence. When opened as low as possible, there is a liability to prolapse, but the normal reservoir for the fæces, the sigmoid flexure, is preserved, and incontinence is not apt to occur. The ideal operation would be a low sigmoid colotomy performed in such a manner as to permit the patient to have good control over the fæcal evacuation. I have recently practised an operation which seems to achieve this ideal:

High Sigmoid Colotomy.—In performing the operation for inguinal colotomy it is perhaps in the majority of cases desirable to open the sigmoid flexure as high as possible. In this manner the undoubted tendency to prolapse is lessened or even abolished; for the sigmoid is brought to the surface at a part where its mesentery is short, and the support of that segment of the bowel engaged in the operation is therefore firm.

The abdominal incision is made on the left side, in a manner precisely similar to that which is adopted upon the right side in the removal of the appendix; that is to say, that the muscles are split, as suggested by McBurney, and their fibres are not divided.

The incision is made with its centre at a line which joins the umbilicus to the anterior superior spine of the ilium, at a distance of $1\frac{3}{4}$ to 2 inches from the anterior superior spine. If the abdominal wall is very lax and pendulous, the incision may be made an inch higher even than this. The skin is divided for a length not exceeding two inches. When the fibres of

Fig. 188.—Colotomy—the muscles are split in the manner shewn: *a*, Fibres of external oblique; *b*, external oblique split; *a* small nick in the internal oblique, at the outer border of the rectus; *c*, the internal oblique and transversalis split.

the external oblique muscle are exposed, it will be found that the incision lies parallel to them. These fibres are split in the direction of their length, and are separated gently from one another. The muscular bundles of the internal oblique are then exposed; their direction is almost at right angles to that of the fibres of the external oblique. A separation of these muscular bundles is effected similarly in the direction of their length. This, which is not always an easy matter, is best effected by beginning the separation of them as near as possible to the outer border of the rectus. A small incision here will divide or separate the fibres of the internal

oblique and of the transversalis which lie beneath it, the transversalis fascia and the peritoneum being exposed. This small incision is lengthened by gently tearing the muscular fibres apart for a distance of about $1\frac{1}{2}$ inches. A small retractor is then placed on each side of the wound, holding the muscles apart, and exposing the peritoneum, in which an incision of an inch, or rather less, is made. The cut edges of the peritoneum are seized with a clip on each side.

The forefinger is then introduced into the abdomen and the sigmoid flexure is sought. As a rule, there is no difficulty whatever in finding it and in bringing it to the surface. The simplest method of seizing it at once is to sweep the finger along the peritoneum on the outer side of the wound across the iliac fossa until the mesosigmoid is reached. A loop of the sigmoid is then drawn to the surface. I make a point in all cases of seeing that the part to be engaged in the wound is the highest part of the sigmoid. The desirability of this was first shewn by Mr. Harrison Cripps. As soon as a loop of the bowel is drawn out of the wound, its upper end is drawn upon until no more of the bowel will come out; at the same time the lower portion of the gut is returned through the wound into the abdomen. When the highest portion of the sigmoid has been reached, a good loop of the bowel is drawn out of the wound and its mesentery is made tense. A close examination of the mesentery is made, so that a bloodless spot can be chosen for the passage of the suture. This spot should be about 1 inch from the gut. The suture is now passed. In over 30 consecutive cases I have used only one suture for the support and fixation of the bowel. This stitch was first suggested by my colleague, Mr. Edward Ward. In introducing it I use a fully curved Hagedorn needle charged with thick Pagenstecher thread. The needle is passed from the centre of the incision on the upper or inner side of the wound, being introduced about $\frac{1}{2}$ to $\frac{3}{4}$ inch from the cut edge, through the skin, external and internal oblique and trans-

versalis muscles, and the peritoneum. The clip which was put on to the edge of the peritoneum, immediately after it was incised, is drawn upon gently, so that it may be seen that the needle takes a good hold of the serous surface. The thread is pulled after the needle until only 6 inches remain on the outer surface of the skin. The needle now passes through the mesentery of the sigmoid at the bloodless spot already selected. During and after the time that this is done the loop of the sigmoid with its mesentery is held firmly in the surgeon's left hand. The thread is

Fig. 189.—Colotomy. Shewing Ward's stitch in horizontal section.

again pulled after the needle, which now is made to transfix the outer or lower margin of the wound, through all its thickness from peritoneum to skin. The thread is now pulled tight between the needle, and the end left hanging from the upper

Fig. 190.—Colotomy. Shewing Ward's stitch in transverse section.

side of the wound. The needle is then returned through the same opening in the mesentery through which it has already passed, the needle is disengaged, and the stitch is ready for tying. On the upper side of the wound are the two ends

of the thread—one going into and through the whole thickness of the abdominal wall, the other emerging from the opening into the mesentery.

On the lower side is a loop. When the suture is tied, a piece of medium-sized drainage-tube is threaded through this loop, so that the thread may not cut into the skin.

As the two ends of the thread are knotted together, a similar piece of tube is placed in the loop so formed. The thread is drawn upon

Fig. 191.—Colotomy. Operation completed.

firmly and deliberately and a double knot is tied. The ends of the thread are then cut, being left about 2 inches long.

This stitch affords a perfectly firm support to the loop of the sigmoid. It secures that a good loop of the bowel shall lie external to the skin, and it draws the skin-edges into the closest approximation with the mesentery on each side. There is no risk, therefore, of the bowel getting adrift or of the wound being opened more widely and a large amount of bowel being extruded. The suture, there-

Fig. 192.—Ward's stitch, in "mattress" form, as seen in horizontal section.

fore, possesses every advantage over the glass rod, or strip of gauze, passed through the mesentery, in the methods adopted by many surgeons.

No other stitches than this single one are necessary. If the skin incision has not been made unduly large, it will be found to fit the loop of the bowel quite snugly. If necessary, a silkworm-gut stitch may be passed at each end of the wound; in these a few fibres of a longitudinal muscular band on the bowel may be included, so as to give a fixed point of firm union at each end. This, however, is not necessary, and is to be performed only when an unduly large wound through the abdominal wall has been made.

Any loose appendices are now ligated at their attachment with fine catgut, and cut away.

Fig 193.—Ward's stitch in "mattress" form, as seen in transverse section.

A square of boiled dental rubber, or of oiled silk, is now applied over and around the loop of the bowel, and an external dressing of wool applied. The whole operation lasts from ten to fifteen minutes and may be done under local anæsthesia.

The supporting stitch may also be passed in the same manner as a mattress suture. The details are shewn in the annexed drawings. My own preference is for the first form of the stitch.

In order to keep the bowel from action and to quiet the possible unrest of the patient, a hypodermic injection of $\frac{1}{4}$ or $\frac{1}{2}$ of a grain of morphine may be given, and repeated at the end of twenty-four hours.

The time at which it is necessary to open the sigmoid flexure varies much in different cases. If there be an acute or sub-acute obstruction, it may be imperative to open the gut at once; in such circumstances the use of a Paul's tube is essential, for it is only in this way that the wound and its immediate area can be kept free from contact with fæcal discharge. If, however, there be no undue urgency, at least three days may be allowed to elapse before the intestine is incised; and in some instances as long as a week may be allowed to pass.

I have in many cases opened the bowel at the end of two, three, or four days, and have allowed the supporting stitch to remain in for several days longer. It is true that until this stitch is removed the bowel does not empty itself quite satisfactorily, but there is free escape for flatus, and for fæces in sufficient amount to prevent distress. The bowel is opened, as a rule, by an incision with the knife of a Paquelin cautery. The opening is made lengthwise into the intestine, and at first should be approximately an inch in length. The cautery should be of a dull red heat, and the division of the coat of the gut made slowly, so that hæmorrhage is prevented. As soon as the lumen is freely exposed it will be seen that the two openings leading from the surface into the proximal and distal limbs of the eventrated loop are separated by a well-marked spur, the end of which lies well above the level of the skin. It is, therefore, a physical impossibility for fæces to pass onwards into the distal opening: they must first escape from the proximal opening on to the surface. Through the distal opening, however, some astringent or antiseptic lotion can be introduced which will pass down over the growth and out of the anus, through a rectal tube. An ulcerating growth in the bowel can thereby be rendered both cleaner and sweeter, and that condition of irritating, ichorous discharge which is sometimes seen can be lessened or prevented.

Low Sigmoid Colotomy.—I have recently performed an operation having for its objects the provision of a controllable

artificial anus and the preservation of the normal function of the sigmoid flexure. The sole disadvantage of the method just described is that the fæcal material as soon as it reaches the sigmoid flexure is free to escape on to the surface. The sigmoid flexure should act, and in health does act, as a fæcal reservoir. If, there-




Fig. 194.—Low sigmoid colotomy. Shewing the bridge of skin under which the upper closed end of the sigmoid flexure, which has been cut through as low down as possible, is passed. The lower incision is shewn much larger than is necessary.

fore, it is opened *as low down as possible* rather than as high up as possible, fæcal material coming down the descending colon will not instantly be discharged upon the surface, but will be collected and detained to a convenient time in a capacious loop of bowel destined for that purpose. As a rule, when the sigmoid has been opened low down there has been a prolapse of the gut through

the opening. This can be prevented by the method now to be described.

The operation is performed in the following manner:

The abdomen is opened by the muscle-splitting incision just described. As soon as the sigmoid is exposed it is drawn *upwards* as far as possible until there is a tight length leading to the rectum. At this point two clamps are placed, and the bowel is divided between them. Both ends of the gut are now in-

 folded and closed by suture. (The bowel may be crushed, ligatured and closed in, if desired.) The distal end of the bowel is fixed to the lower angle of the wound by a couple of stitches which include the peritoneum and the wall of the intestine. The upper end is freed a little, so as to render it more mobile without denuding it of its blood-supply, and is brought out of the wound as far as possible.

A few stitches fix it to the peritoneum, and the muscles are allowed to return to their former position. The upper closed end of the gut is now treated in one of two ways: either it is, if freely mobile and of good length, passed upwards and inwards under a bridge of skin, made by undermining the skin on the inner

Fig. 195.—Low sigmoid colotomy. Section shewing the lower end closed and returned within the abdomen, and the upper end brought to the skin. A pad pressing in the direction of the arrow prevents leakage.

side of the wound for an inch and a half; a second smaller incision is then made through which the end of the bowel is pulled, and the original wound is closed. Or, if the bowel be but little mobile, being held by a tight mesentery, it is brought at once to the skin surface of the original wound, being twisted on its axis for half a circle.

If the former method is possible it is the more desirable; for after the bowel has been opened, the subcutaneous part of it may be so compressed by a pad fixed upon an abdominal belt as to be perfectly controlled,—controlled so efficiently, indeed, as to prevent even the passage of flatus, to allow which to pass the pad must be lifted away from the abdomen.

The opening of the bowel is left for two, three or four days, as seems necessary.

I believe it is to Wyeth, of New York, that we are indebted for this suggestion as to the continued usefulness of the sigmoid reservoir.

THE LUMBAR OPERATION.

Lumbar colotomy is performed in a manner precisely similar to that which is adopted in the inguinal operation; the sole differences are in the position chosen for the skin incision and in the fact that the descending colon, which is not at all or scantily provided with a mesentery, is opened instead of the sigmoid flexure. The incision which is most convenient is that which is generally known as Bryant's incision.

The patient lies well over on the right side, and in the hollow of the right loin a firm, rounded sand-bag is placed.

The incision is oblique and falls upon the skin between the last rib and the iliac crest.

The line of the colon is marked on the surface from a point half an inch behind the middle of the line joining the anterior and posterior superior spines vertically upwards. The centre of the incision lies upon this line.

The incision divides the skin, thick subcutaneous tissues,

and the muscles down to the fascia lumborum, which is opened by a small incision. The opening is widened by gentle tearing. The fat around the kidney is now exposed and is gently displaced or torn away with the fingers. In front the peritoneum will be seen.

The peritoneum is then deliberately opened on the outer side of the colon. When this has been done, there is no difficulty whatever in discovering the colon. As a rule, it comes unbidden to the surface and is seized at once. If it should not do so, the left index-finger is passed into the wound towards the spine, and is made to sweep along the front of the kidney until it is felt to meet the colon, which is hooked upwards and drawn out of the wound. By pulling gently upon the colon the peritoneum on each side of it is also drawn upon, in such manner as to fashion a sort of mesocolon. It is through this mesocolon that Ward's stitch, already described and illustrated, is passed. Mr. Ward devised this most satisfactory suture expressly for the operation of lumbar colotomy, and it is safe to say that no method for the performance of the operation approaches this one, so far as the perfect character of the opening—and, therefore, so far as the comfort of the patient—is concerned.

In some patients the depth of the wound may make it necessary or desirable to introduce a small drain in the posterior half, or possibly in the anterior half also, in order to prevent an accumulation of serous fluid in so deep a pouch. In rarer instances the wound from the skin to the peritoneum may be of so great a depth that the colon cannot be made to reach the surface. In such circumstances there is nothing to be done but to close the wound and to open the abdomen in the manner already described by an incision for the performance of inguinal colotomy. Such a condition of things, it is true, is rarely met with, but I was unfortunate enough to experience it in one case.

The difficulty due to an extremely short mesentery may

also be encountered in inguinal colotomy. If so, it may be overcome in one of two ways: either the parietal peritoneum may be stripped from the edges of the abdominal wound and tucked down to the sigmoid flexure by a series of sutures, the opening of the bowel being delayed for several days; or the bowel may be cut completely across, and each cut end gently stripped up until it can be made to reach the surface, or, better, to project well beyond it; the bowel is then stitched to the skin. A part of the ends may slough, owing to defective nutrition, but enough will remain to ensure an adequate opening on the surface.

LILIENTHAL'S COLOTOMY.

Colotomy after the method of Lilienthal is performed as follows: A muscle-splitting incision $3\frac{1}{2}$ to 4 inches long is made through the left rectus, the upper end of this incision reaching almost to the line of the umbilicus. The abdomen being opened and explored, a loop of the sigmoid flexure is drawn out. The two limbs of this loop are sutured as widely as possible apart, one to the peritoneum and rectus sheath, at the upper end of the incision, the other similarly at the lower.

Silk or linen thread is used for the suture material. Lilienthal stitches with a continuous suture, tying every third stitch so as to avoid closing the lumen of the gut. The mesosigmoid is sutured by a through-and-through stitch to the peritoneum on each side. The gut is now divided at the lower end of the loop between two ligatures, and the mucosa sterilised with pure carbolic.

Mattress sutures are passed through the mesosigmoid, which is then divided so as to separate a longer length of colon.

At this stage of the operation the condition of affairs is as follows: There is a short piece of sigmoid—the distal loop—sutured to the lower angle of the wound, and a long piece (3 or 4 inches) completely freed except at its attachment to the upper angle of the wound. Four clips are now placed on the mouth of

the proximal loop, and a finger inserted into the lumen up to the site of suture to the peritoneum.

The clamps are then rotated by the assistant around the longitudinal axis of the gut in such a manner as to produce a certain degree of constriction, the degree of rotation necessary varying from 180 to 300 according to the thickness of the sigmoid. A few

Fig. 196.—Lilienthal's colotomy.

interrupted Pagenstecher sutures are now passed from the muscular aponeurosis of the external oblique to the gut, taking in the submucosa. As many of these stitches as are necessary to hold the sigmoid in the twisted position are inserted. The anterior sheath of the rectus is now closed, a rectal tube is tied 6 inches into the gut, and the remainder of the wound packed with gauze.

The tube is removed in about seven days, and the redundant

sigmoid cauterised. The ligature round the lower piece of intestine is removed in three or four days.

Lilienthal ("Annals of Surgery," 1910, vol. lii, p. 384) claims that the advantage of this colotomy over all others is that the patient has control over the opening and that consequently no appliance beyond a simple bandage need be worn. This control



Fig. 197.—Lilienthal's colotomy.

is dependent chiefly on the sphincteric action of the left rectus. There is also a sphincter at the site of the rotation and an angulation at the point of peritoneal fixation.

I perform the Lilienthal colotomy in a fashion exactly similar to that followed in the inguinal and iliac operations, using Ward's deep stitch, but without division of the sigmoid at the primary operation.

CHAPTER XXIV.

ENTERO-ANASTOMOSIS, LATERAL ANASTOMOSIS, OR SHORT-CIRCUITING.

By lateral anastomosis, or short-circuiting, of the intestine is understood the creation of a communication from the bowel above to the bowel below an impenetrable or irremovable stricture. A lateral anastomosis may be used either as a final, perhaps the only possible, operation, as in cases of growth of the intestine causing partial occlusion, when secondary de-

Fig. 198.—Entero-anastomosis (isoperistaltic).

posits in the liver or elsewhere are already present, or as a temporary measure, to give present relief to urgent symptoms, and thereby to prepare the way to a later resection of the growth. If, for example, there be a large, adherent, irremovable malignant mass in or near the cæcum which is causing intestinal

occlusion, the ileum above the growth may be united to the colon at any point well beyond the growth—to the transverse colon or the sigmoid flexure, for example. The operation of short-circuiting is one of frequent use and of great service in any part of the alimentary canal. Gastro-enterostomy for pyloric obstruction, entero-anastomosis, ileosigmoidostomy, are all operations that have served the surgeon well.

It is impossible, in any brief statement, to disclose the various indications for the performance of entero-anastomosis, but a few of the more important may be named.

1. In intestinal obstruction due to growths in the large or small intestine, where primary resection is impossible or inadvisable. The performance of enterostomy, formerly much practised, is considerably curtailed if this indication be observed. Lateral anastomosis in these circumstances is as simple and as safe as enterostomy, and is free from all the unpleasing attributes of a fæcal fistula.

Fig. 199.—Entero-anastomosis (antiperistaltic).

2. In cases of simple stricture of the intestine due to cicatricial contraction following strangulated hernia, etc.
3. In cases of tuberculous disease of the intestine with extensive and inseparable adhesions, with the matting together of many feet of intestine in intricate confusion.
4. In some cases of multiple adhesions due to recurrent appendicitis, before or after the removal of the appendix, when symptoms of intestinal difficulty are present.
5. As a part in the operation of intestinal exclusion.

The range of usefulness of this operation is considerable

its safety remarkable, and its performance as simple as that of any abdominal operation. In comparison with end-to-end anastomosis it presents the undoubted advantage of having the line of anastomosis completely encircled by peritoneum. There is no weak spot, as there is at the gap in the mesentery. Leakage, therefore, and difficulty of suture have not to be reckoned with; the only point requiring care and judgment is the selection of the most fitting place for the anastomosis.

In cases of obstruction due to growth a point some distance above the growth should be selected, for that condition of infection and ulceration of the mucosa which prevents the healing of a wound in end-to-end anastomosis may also wreck a lateral approximation. It is just as essential in this operation, as in resection, to suture only healthy portions of the bowel. Lateral approximation should not be made, therefore, too close to the growth on either side, and portions of the bowel alone should be selected which permit of ready apposition without drag or tension.

So far as the means of effecting the junction are concerned, it is only necessary to say that no other method than that of simple suture should ever be considered. In the early days of my experience I used the Murphy button to effect an ileo-sigmoidostomy, and despite the fact that the heavier end was placed in the sigmoid, the button made its way into the cæcum and caused ulceration and perforation. Of the method of simple suture, one may safely claim that it is as easy as any other method; that with practice it can be performed with equal rapidity; that disaster to the suture-line is unknown; that it leaves nothing behind which can, in the after-days, be a source of danger, and that in actual practice it is undoubtedly the most satisfactory. In short, all its attributes are those of excellence: it leaves nothing to be desired.

The following is the method I adopt: The appropriate loops of bowel having been chosen, they are drawn out of the abdomen and clamps are applied. It is necessary to ensure

that the loops to be united are applied to each other so that they are isoperistaltic. In the small intestine this is perhaps of little importance, but when the small and the large intestine are applied, it is undoubtedly an advantage. This disposition of the parts is ensured by seeing that the proximal portion of the gut is always placed near the pivot end of the blade of the forceps, and the distal portion of the gut towards the tip of the blade. The forceps so embracing the bowel are now made to lie side by side, and hot moist mackintosh cloths surround them, and a special rolled compress lies between them. The suture is then applied. The needle is the usual curved needle, and the thread is the finest Pagenstecher. A continuous seromuscular suture is first introduced, along a line about 2 to 3 inches in length. The suture is knotted after the first stitch and the end is left long; it is then continued without interruption or knotting. The suture-line lies about $\frac{1}{4}$ inch from that portion of the bowel most distant from the mesentery, on the sides of the bowel which, in this position of the clamps, are in contact. After the suture reaches the portion of bowel at the tip of the clamps' blades, the needle is laid aside. The intestine in front of this line of suture is now opened by a straight incision about 2 inches in length, which divides all the coats down to the mucosa. As the knife cuts through these coats they retract, until, by the time the mucous membrane is reached, an ellipse of it lies in between the wound-edges. This ellipse is removed; a snip of the scissors is made through the mucosa at one point, and the scissors are then carried around the whole ellipse until it is free. The same is done with each portion of the gut. There will be no bleeding from the cut edges of the intestine, for the clamp which holds it acts as a temporary hæmodynamic. The lumen of each portion of the bowel is emptied and thoroughly cleansed with gauze swabs, which are thrown away as soon as they are soiled. Care must be taken that neither the fingers of the surgeon nor of his assistant nor any of the parts around are soiled with the intestinal contents. The inner su-

ture is now introduced, beginning at the proximal end of the incision. A similar needle and the same size of thread are used. The suture embraces all the coats of the gut. After the first stitch the thread is knotted, the end left long, the suture then continued along the posterior margin of the incisions to the distal end of the wound, and, finally, the suture is continued around the anterior margins until the point of starting is reached, when

Fig. 200.—The inner suture in lateral anastomosis to shew the infolding of the mucosa which results. A loop of the suture lies on the mucous surface.

the end originally left long is tied with the end in the needle and the threads cut short. This inner stitch secures a perfect apposition, which is water-tight, and it is drawn sufficiently tight to secure the vessels in the cut edges. As each stitch is passed the thread is drawn upon with sufficient tension to lift up those portions of the intestine into which the needle has next to pass. The stitch is continuous throughout; there is no fear

of its causing a puckering of the wound-edges. With this suture special care must be taken to infold the mucosa. This may be done by changing the suture when the posterior part of the intestine has been sutured. When this point is reached, the needle is passed from the mucosa of the bowel which lies to the surgeon's left through all the coats to the serous surface. Then on each side the needle picks up a piece of the edge in a suture which lies parallel to the cut margin, the loop of the suture being always on the mucous surface (Fig. 200). After the completion of this suture the clamps are removed, and a general cleansing of the bowel and of the hands is made, for the mucosa, which is probably infected, is now closed off. It is often desirable for the surgeon to change his gloves. If any point in the cut edges shews any sign of bleeding, an interrupted suture is introduced and tied with sufficient force to arrest the hæmorrhage. The first needle, which carried the seromuscular stitch, is now picked up and the suture continued round in front of the inner stitch and about $\frac{1}{4}$ inch from it, until the point from which it started is reached. The end of this outer suture, if dragged upon by an assistant, will facilitate the introduction of the stitch around the anterior half of the wound. The two ends of the suture are now tied and cut short and the anastomosis is complete. A reference to the diagrams used in the description of the operation of gastro-enterostomy will here be useful.

A junction between two portions of the bowel effected by this suture is water-tight at once. The inner suture secures that. It is remarkable how rapidly the outer suture, securing accurate peritoneal approximation, ensures a firm union. In one case, a woman of sixty-seven, I performed ileosigmoidostomy for acute obstruction depending upon a growth in the cæcum. After the anastomosis was complete an assistant stretched the sphincter and I milked a very large quantity of thin faecal material through the opening into the sigmoid and rectum. The patient died twenty-three and one-half hours

after the operation, and the suture could hardly be recognised, so perfectly was it sealed off by accurate peritoneal adhesion. The general appearance of the parts was such that it was difficult to believe that so perfect a healing had been possible in so short a time.

The same technique is adopted in all circumstances. The only difficulty that I have met with is that in some instances the mesosigmoid is so short that the bowel cannot be drawn outside the abdomen. I have found that a pair of Doyen curved clamps, applied so that the concavity is forwards (towards the operator), is then a help. If these cannot be used, then the sigmoid must be temporarily held by an assistant.

CHAPTER XXV.

ENTERECTOMY.

ENTERECTOMY, or the removal of a portion of the intestine, may be performed upon the small intestine, in any part of the colon, or at the ileocæcal junction.

Removal of a portion of the bowel is necessary in the following conditions:

1. In new-growths.
2. In stricture of the intestine due to former or present ulceration, most frequently tuberculous in character, or following upon strangulation.
3. Gangrene of the intestine, due to strangulation in a hernial sac, or occurring in intestinal obstruction.
4. Irreducible intussusception, associated with growth, simple or malignant.
5. In some forms of perforation of the intestine where two or more wounds lie close together, as in gunshot wounds.
6. In extensive lacerations of the intestine or of the mesentery, of the kind found in "buffer" accidents, or as the result of a bayonet or stab-wound.
7. In certain cases of fæcal fistula, designedly or accidentally produced.
8. In cases of growth in the mesentery when the vascular supply of the bowel is endangered.

The subject will be considered under the following headings:

Resection of the small intestine.

- (a) For growth or stricture, or in cases of mesenteric tumour when the vascular supply of the gut is involved.
- (b) In cases of gangrene dependent upon strangulated hernia or in acute obstruction.

Resection of the large intestine.

(a) For growth.

(b) For growth causing acute obstruction.

RESECTION OF THE SMALL INTESTINE.

(a) **Resection of the Small Intestine for Growth or Stricture.**—

Growth of the small intestine is infrequent. I have only been called upon to remove malignant growths from the ileum or jejunum on seven occasions. Tuberculous stricture following upon ulceration is occasionally seen, and in some instances the thickening in the gut may be so marked as to cause a strong resemblance to primary growth.

The abdomen is opened, as a rule, through the middle line. If the tumour, perceptible before the operation, seems fixed in any part of the abdomen, the incision may be made directly over the most prominent portion of it. The abdominal incision is made in the usual manner, and the hand is introduced into the abdomen and a general examination of the parts is made. If, on careful exposure of the growth, it is found that a decided obstruction is caused by it and that the gut on the proximal side is acutely distended, no resection operation can be undertaken. Enterectomy, followed by primary suture in cases of intestinal obstruction due to growth, is doomed to failure. A lateral anastomosis between the bowel above and the bowel below the growth will then be undertaken. If, however, all the conditions are favourable for resection, this should be done.

The bowel is first carefully isolated. There may be adhesions binding the growth to the abdominal wall, to a neighbouring coil of intestine, or, as is most commonly the case, to the omentum. Many of these adhesions give way under gentle pressure or with gauze stripping. They should always be detached firmly but gently. Roughness and impatience are out of place. Omental adhesions are ligated off about $1\frac{1}{2}$ to 2 inches from the growth if possible. If any part of the intes-

tine is adherent to the growth, it should be separated with especial care. In three cases of my own (two of growth, one of tuberculous disease) a separation was quite impossible, and the adherent loop of bowel had to be excised, a double enterectomy being performed. On a subsequent examination with the microscope the adherent loop was found, in each case, to be invaded extensively by growth. In cases of tuberculous disease the adhesions are even more binding and more complex than in cases of growth.

The adhesions having been separated, the involved loop of gut is drawn well out of the abdomen, so that the full extent of the disease and of the glandular enlargement can be

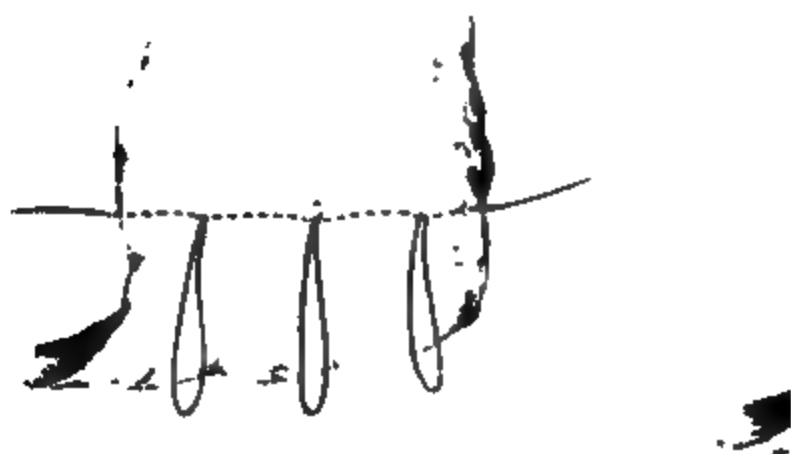


Fig. 201.—Ligation of omentum. The interlocking ligatures.

seen. The limits of the excision having been determined upon, as many large swabs as are necessary are placed in position, so as to isolate the area of operation, these being covered in turn by mackintoshes.

The intestine having been isolated and the general peritoneal cavity shut off by the packing of swabs, the resection is begun. In the case of the small intestine it is always possible to do this outside the abdomen, and there is every advantage in so doing it. The limits of the gut to be removed being determined, the intestinal clamps are applied. Four pairs are necessary—two pairs at each point of section. If the intestine is at all distended with fæculent material or with flatus, the lower

clamps can be first applied, the bowel divided, and the upper cut end drawn away from the wound, its clamp removed, and the bowel allowed to drain away its contents into a dish. The upper clamps are then applied and the intestine between them divided. As a rule, however, no emptying of the intestine is

Fig. 202.—Enterectomy Removal of growth of intestine, with mesentery and glands. The parts are ready for an end-to-end anastomosis.

necessary, and the clamps both above and below may be applied at once. In placing them in position it is important to remember that they must not be at right angles to the longitudinal axis of the intestine, but that they must lie obliquely, so that their tips approach one another. A triangular portion of mesen-

tery with its portion of bowel is therefore partly included in the grasp of the clamps, the apex of the triangle being towards the root of the mesentery, the base being, of course, the bowel to be removed. By so applying the clamps an adequate blood-supply for the cut ends of the gut is assured, and a slightly larger section of the intestine is left for the anastomosis. The bowel is now divided at each end, and the cut ends at once cleansed with many swabs wrung out of saline solution. As soon as the division is made, each end of the intestine is temporarily wrapped in a swab of gauze and carefully protected so that no

Fig. 203.—The lines of section of small intestine and mesentery in a case of enterectomy (Hartmann).

soiling of any part of the operation area by contact with a certainly infected mucosa can occur. The incision is carried onwards, obliquely into the mesentery, and any bleeding points at once seized with clips. Or, as is my usual practice, the apex of the wedge of mesentery to be removed is found and isolated and a broad clip of my own pattern is applied to it. The clip is squeezed home and allowed to remain for a few seconds. When it is removed, a deep groove will be seen, all except the vessels and the peritoneum having been squeezed away by the pressure of the forceps. Into the groove so left a catgut ligature

or a fine Pagenstecher ligature is placed and tied. A clamp is then applied about 1 inch distal to the ligature, and the mesentery between them is divided. The remainder of the mesentery is now cut through on each side, and the whole affected loop is free. Some vessels in the cut mesentery near the bowel will require clipping. In this portion which is now removed will be the growth, a length of healthy bowel on each side, and a wedge of mesentery containing all the lymphatic vessels and glands draining the diseased intestine. The condition of affairs at this stage of the operation is represented in Fig. 160. A general cleaning-up of the operation area is now necessary. The mackintoshes are changed, the ends of the bowel are cleansed again, and the hands are well rinsed in fresh sterile salt solution. The approximation of the divided ends by suture is now begun. The clamps are drawn together and laid side by side, and wrapped around with hot moist gauze. If the upper opening of the bowel is rather larger than the lower, as may be the case, a longitudinal incision is made into the lower portion along a line most distant from the mesenteric attachment. The stitches are now introduced. That portion of the bowel at the mesenteric edge is first stitched, and very especial care is taken with the first few turns of the needle. The first stitch is seromuscular, and picks up the outer covering of the bowel about $\frac{1}{4}$ inch from the cut edge. The suture begins near the mesenteric attachment, and, in the first two passages of the needle, only the mesentery is pierced on each side. As the mesentery reaches the intestine its layers separate, leaving a triangular gap. It is the mesentery bounding the triangular gap which is picked up by the first turns of the needle. The suture is then continued, including the serous and muscular coats only (perhaps the submucous, or a part of it, also), until one-half the circumference of the bowel is united, until, that is to say, the part of the gut most distant from the mesentery is reached. The needle is then laid aside.

The inner suture is now introduced. This includes all the coats of the bowel, and ensures two results—a perfect mechani-

cal approximation of the divided ends of the bowel and hæmorrhage. It is not necessary to clip and to ligate any points in the cut edge of either end of the intestine. To introduce the stitch skilfully some practice is required. Owing to prolapse or retraction of the mucosa, it may be difficult to pick up, on the needle-point, precisely that amount of intestine which is necessary. The stitch may at first be drawn overtight; it is more likely, however, that it will not be drawn tight enough. I have found the best standard of the necessary degree of tight-

ness that which results from a drag upon the thread from the last stitch of a degree sufficient to raise up, prominently, that part of the walls of the intestine into which the needle is next to pass. If the thread be drawn steadily and held firmly upwards, it raises the portion of bowel through which the needle last passed, and makes prominent that part which is about to be caught up in the needle. It is the first two turns of this suture which are of the chiefest importance. By them the gap at the junction of the mesentery and of the bowel is closed, and a perfect serous apposition ensured. As the two openings lie side by side there are two triangular gaps, in the right and left di-

Fig. 204.—End-to-end anastomosis after enterectomy.

vided ends of the intestine. The stitch is begun by being passed from the mucosa of the lumen of the bowel on the right, through all the wall of the bowel, and through that portion of the mesentery which has just separated from its fellow at the gap; from there the needle passes to the bowel on the left, transfixing all the coats, beginning with the separating layer of mesentery and passing then into the lumen of the bowel; from here it pierces the mucosa about $\frac{1}{2}$ inch from the point of its last emergence through all the coats and through the other leaf of the mesentery; and, finally, it passes from the mesentery to

the mucosa of the portion of intestine to the right, entering the lumen of this bowel through the mucosa about $\frac{1}{8}$ inch from its original point of entry; the suture is tied and the end left long. (A reference to the annexed diagram will make the path of the needle clear.) The suture is now continued around the posterior half of the margins of the opening, embracing all the coats and being pulled fairly tight and even. No puckering of the gut need be feared. Each individual portion of the stitch must be separately tightened. If one loop be left slack, it cannot be tightened later without releasing all the stitch. The suture approximates first the posterior margins, and then, without change or interruption, is passed along the anterior margins until the end, left long at the first stitch, is reached, when the thread is knotted and cut short. As the stitch passes along the anterior margin it is important to see that the mucosa is infolded. This may best be done by changing the type of stitch. The needle is passed twice through the bowel on each side: from serosa to mucosa and back again to serosa on the one side, then similarly on the opposite side, so that a loop lies always on the mucous surface. As the suture is tightened the mucous membrane is infolded. The last turn of this stitch passes from serosa to mucosa only, and there the knot is tied. The clamps are now removed from the intestine, as the ends are securely closed, in order to see if the suture-line bleeds at all. As a rule, the hæmostasis is perfect, but once and again a point will be found to bleed. A separate interrupted stitch is then passed to include this point. The arrest of the hæmorrhage being complete, the bowel is again gently washed, and the seromuscular stitch,

Fig 205.—End-to-end anastomosis continued.

laid aside for a time, is now restarted. The circuit is completed by carrying this suture along the anterior margins until the mesentery is reached. Two turns of the needle are then

Fig. 206.—The first portion of the inner suture is almost complete. This is the point at which the character of the stitch changes, as shewn in next illustration.

Fig. 207. — The inner through-and-through suture is changed here. The needle having reached the mucous surface of the left opening is passed in on this side again from mucous to serous surface. Then on the right side it passes from serous to mucous and back from mucous to serous surfaces, so that a loop is always left on the mucosa.

taken in the mesentery, and, finally, the needle is passed through the mesentery to the deeper (or posterior) side, where it meets the end originally left long. The two ends are tied and cut short.

A perfect apposition results. The weak point in the suture-

line—the gap at the mesentery—is strengthened by both stitches, and a leakage is virtually impossible.

Throughout the whole procedure of suture introduction the greatest neatness, precision and fineness must be exercised, for here, more than anywhere, the surgeon's reward is in strict proportion to his deserts. A faulty suture will always cause leakage; nothing can prevent its doing so; a suture properly applied will secure perfect union.

The slit in the mesentery has now to be closed, and the bleeding points in the cut edges to be ligated. It is generally advised that a through-and-through stitch should be used to close the mesenteric wound, but I have found such stitches a source, not infrequently, of trouble. A small vessel may be punctured and a hæmatoma rapidly forms, or at any point where the needle punc-

Fig. 208.—The inner suture continued. Note the loop always on the mucosa. When the stitch is tightened the cut edge of the mucosa is infolded and serous apposition secured.

tures some hæmorrhage may be started. I have, therefore, ceased to use sutures in the mesentery. The plan I adopt is, to tie any bleeding point in the cut edge of the mesentery, and in the same ligature to include subsequently the exactly opposing point in the opposite cut edge. This is done at each point where a clip had been placed, and if the ligatures are not sufficiently close, a clip is in-

Fig. 209.—End-to-end anastomosis continued.

troduced on the cut edge of one side, a ligature applied, the clip removed and at once put upon the corresponding point in the opposite edge, which is then taken in the same ligature.

In cases of growth in the mesentery, when the removal of the growth involves the destruction of the blood-supply to the intestine, a resection of the gut cannot be avoided. So much of the bowel must be removed as seems, in each case, to be necessary. As a rule, there is no difficulty in seeing what the limits of such a resection must be, though to one unaccustomed to this branch of surgery, the extensive removal may seem surprising. The mesentery may be likened in its

Fig. 210.—End-to-end anastomosis continued.

Fig. 211.—End-to-end anastomosis continued.

shape to an open fan, the smaller end representing the posterior attachment. This attachment is approximately six to eight inches in length, whereas the intestinal attachment of the mesentery is eighteen feet in length. A small wound in the posterior portion of the mesentery leaves perhaps several feet of the gut bereft of its blood-supply. A small wound in the terminal branches of the superior mesenteric artery is inevitably followed by gangrene of the bowel. If the wound be in the second series of vascular arches, it is possible for the circulation to be carried on through the free lateral anastomoses.

Resection for Tuberculous Disease of the Intestine.—Tuber-

culous stricture of the intestine possesses many points of especial interest. The disease is far from uncommon; it affects the sexes indifferently, and, owing to the fact that fibrous hyperplastic changes are frequent, a mistaken diagnosis of carcinoma may be made. The favourite sites of the disease are the lower end of the ileum and the cæcum; multiple strictures may exist close together, or they may be scattered at irregular intervals over several feet of the small intestine. When the ileocæcal region is affected, a diagnosis of chronic appendicitis



Fig. 212.—End-to-end anastomosis continued. Ligature of opposing points in the divided mesentery.

Fig. 213.—End-to-end anastomosis; the operation concluded.

or of malignant disease may be made. The fullest and most accurate account of this disease is that given by Mr. F. M. Caird in the "Scottish Medical and Surgical Journal," vol. xiv, p. 20, and I therefore quote at length from this article:

"The clinical features in the cases under consideration present a long history of failing health and indigestion associated with progressive emaciation. A personal and family history of tubercle can generally be obtained. The bowels are usually constipated, and purgatives are generally required. Severe

colic, pain, and tenderness become gradually pronounced. A salient feature is the presence of loud borborygmi, which not only annoy the patient, but are frequently audible to bystanders. Vomiting may be frequent and often gives relief. Hæmatemesis is not met with, nor the passage of blood, although piles may co-exist. The abdomen becomes swollen and tense. Ladder-like patterns and marked peristaltic waves are seen. A tumour may be palpated in ileocæcal cases. Owing to the site of the lesion, complete obstruction does not readily occur, unless the stricture becomes impermeable and is blocked with some foreign body, or is complicated by adhesions to adjacent coils of intestine.

"The principles common to enterectomy for malignant disease—gangrene of the bowel, etc.—guide us in dealing with tubercular stricture, but the operative measures are frequently more difficult, and this is especially the case when we have to deal with adhesions. One may shell a loop of intestine affected with carcinoma from out a mass of surrounding, dense, inflammatory tissue, as in cases of adherent cæcal and sigmoid tumour; but in tubercle there is greater infiltration, and while carcinoma may be shut in by the new fibrous tissue, the tuberculous process frequently bursts through the muscular and serous coats and infiltrates widely.

"The free, non-adherent strictures of the small intestine give rise to less trouble, but in any case an anxious element exists in the wide-spread implication of lymphatic glands, which may necessitate a far-reaching removal of mesentery and entail the sacrifice of healthy intestine. Or, again, some of the caseating glands may have softened or suppurated, and may rupture into the peritoneal cavity during manipulation, and so determine a fatal issue. In operating, then, let the patient be suitably prepared, cut wide of the diseased area, and see that the distended intestine above the stricture be thoroughly emptied. It is always important to plant the sutures in healthy, non-congested bowel.

"We have three classes, which may be treated as follows:

"1. If the strictured area be non-adherent, be localised and solitary, divide well above the proximal dilated portion, since there is a tendency for development of secondary tubercle at points of erosion and ulceration above the primary

lesion. Always search for other strictures. Should there be multiple strictures separated by a lengthy interval of healthy intestine, without glandular implication, it is better to deal with each stricture individually than to excise an undue length of the alimentary canal.

"2. In dealing with an area of coils matted to each other, it is advisable to ascertain, in the first place, the extent and relation of the parts involved. One next carefully identifies the free, healthy proximal and distal intestine, and, applying clamps, proceeds to remove the entire mass. The mesenteries may be divided close to their origins, as this entails the ligation of fewer, if larger, vessels, and allows one to remove all the lymphatic glands. As already indicated, since the latter cannot well be dissected out without damage to the blood-supply of the intestine, it may be necessary to remove much bowel in clearing away the infected glands. Should the mass at any point be firmly adherent at one point to an adjacent healthy loop, it would appear needful to excise the implicated wall of that loop and so avoid the possibility of leaving a future focus of disease.

"3. When there are numerous adhesions of coils not only to each other, but also to adjacent strictures, so that the mass cannot be liberated without grave risk, it might be safer to sever the healthy proximal and distal coils of gut, and unite them end to end. The divided lumina in connexion with the diseased area may now be conducted externally, so as to open on the abdominal wall. Had this method of complete occlusion been practised in one of the cases, the patient's life might have been saved, and the tuberculous area thus left *in situ* might have undergone atrophy, or might have been removed at a later date, under more favourable circumstances. It is also probable that a short-circuiting by lateral anastomosis may occasionally give better results, as has been found by others, but, on the whole, radical measures are usually to be favoured."

(b) **Resection of the Intestine in Cases of Acute Obstruction or in Cases of Strangulated Hernia.**—Gangrene of the intestine as the result of strangulation within the abdomen or in a hernial sac depends in part upon the tightness of the constriction,

in part upon the virulence of the micro-organisms which are present in the ensnared loop. An examination of the parts in such cases will shew that the acute infective process is most intense in this loop, but that it is by no means confined solely to it. The acute inflammation, leading on to ulceration or even gangrene, and the bacterial invasion of the coats of the bowel extend upwards and downwards in the bowel, but to a greater length and to a much more severe degree in the part above the constriction than in that below. In all resection operations undertaken for gangrene it is, therefore, necessary to cut through the bowel, on each side, wide of the gangrenous portion, but, especially, to remove freely on the upper side. The extent to which the bowel should be removed is not always easy to determine, for the gut, after division of the constriction, may, from a seemingly hopeless condition, slowly change its appearance and become almost normal. In all these cases, therefore, the intestine should be subject to the most careful examination, and the condition of the vessels of supply in the mesentery be determined. If the veins are thrombosed, and if the arteries have ceased to beat, the bowel, though it may recover its colour and appearance after release of the constriction, is probably not in a satisfactory condition for suture. In several recorded cases, and in some few observed by myself, an enterectomy performed in such circumstances has failed by reason of gangrene and leakage at the line of suture or from gangrene and perforation in the proximal portion of the bowel. It is better to err, if an error must be made, on the side of free removal. It is not the length of the bowel removed in these cases which makes the operation hazardous, for two feet of the intestine are removed as easily as two inches, but the inadequate removal of bowel seriously damaged and gravely infected, with vessels thrombosed, and the performance of an end-to-end anastomosis in a part of the bowel which cannot heal.

The removal of the bowel, therefore, must be free, espe-

cially upon the upper side. The anastomosis of the divided ends is carried out in the manner already described.

It is especially in these cases of overdistension of the intestine as the result of acute intestinal obstruction that the device already mentioned of emptying the intestine is of greatest service. The clamps on the lower side of the gangrenous loop are first applied and the bowel is divided between them. The proximal portion of the bowel is then freed from its mesentery to a degree which will permit its being drawn away from the wound for six to eight inches. The clamp which closes its end is then removed, and the gut allowed to empty itself of air and fluid motion. The bowel above the obstruction is emptied by "milking" until the overdistension is completely relieved. The clamps are then applied above, and the diseased bowel removed. The removal of the mesentery to the same extent as in cases of growth is not necessary. The method shewn in the diagrams annexed (Figs. 214 and 215) may be followed.

The length of the small intestine in man varies greatly, so that a standard measurement cannot be assigned to it. It varies according to the height of the individual and according to his nationality. The intestine in Russians and in Italians would seem to be longer than in the other races in Europe; this is doubtless due to the different character of their food. In those who live largely or entirely upon bulky vegetable foods a greater length of intestine is found. Beneke, after comparing the height of the individual and the length of the intestine in a series of cases, stated that for every 100 cm. of body length, there is, on the average, 387.5 cm. of small intestine.

In discussing the question of removal of great lengths of the small intestine it is, therefore, not of so great importance to know the amount of the bowel removed as it is to know the length of the bowel which remains. The extreme variations in the length of the small intestine are said to be 15 feet and 33 feet. The average length is given by Treves as 22 feet 5 inches (683 cm.). A patient whose intestine was 30 feet in length would, therefore,

be able to submit to a more extensive resection than a patient whose intestine was 20 feet in length, or perhaps even less than



Fig. 214 —Enterectomy. The mesentery is ligated off close to the gut (after Kocher).



Fig. 215. —Enterectomy—folding of the mesentery (after Kocher).

this. Furthermore, the functional activity of the remaining intestine is of the first importance. If the gut which remains is

thin and atrophied, as the result of being on the distal side of a long-standing obstruction, or if the coils of the bowel are intimately adherent, then the value to the patient of such intestine is not represented accurately by a mere statement of its length. It would seem possible that the age of the patient is also a factor of importance, the intestinal canal in young patients being better able to undergo compensatory changes. In Ruggi's case 330 cm. were successfully removed from a boy eight years of age; and in Blayney's case, 255 cm. from a boy of ten. In this connexion it may be mentioned that in Monari's experiments, as in Senn's, it was found that in the dogs which shewed no intestinal disturbance after operation a well-marked hypertrophy of the intestine was found. There is no ascertained difference in the results which follow removal of the jejunum from those which are found after resection of the ileum. Viewed from the standpoint of the physiologist, it might be expected that excision of say half the small intestine at the jejunal end would result in more serious consequences than a similar excision at the iliac end. Diliberti-Herbin ("Zent. f. Chir.," 1904, No. 4) found no difference in the digestive capacity in two dogs who had lost one-half of the small intestine, the upper half having been removed in one, and the lower half in the other. Observations were continued for ninety-three days, and though at first there was marked lack of assimilation both of the nitrogenous material and of fat, the dogs soon began to gain in weight, and both recovered perfectly.

These observations do not agree with those of Trzebicky, quoted by Blayney ("Brit. Med. Jour.," 1901, ii, 1456), whose conclusions as a result of 28 extensive resections of the small intestine performed on animals were as follows:

Resections of half the small intestine were tolerated quite well. Resections of two-thirds and upwards of the jejunum and ileum made such an inroad on the chemical and mechanical processes of digestion that the prolongation of life became impossible. There was incessant diarrhoea, followed at a later stage by vomiting; food was voided for the most part undigested, and, in spite of a craving appetite, the animals perished with symptoms of

complete inanition. Trzebicky also observed that the effects of the resection of the beginning of the jejunum were more serious than those of resection nearer the ileocæcal valve—a result to be expected considering the wider, thicker, and more vascular condition of the jejunum. Transferring his results to the human subject and taking 560 cm. (18 feet 5 inches) as the minimum length of the small intestine, he declared that resection of one-half of it—that is, 280 cm. (9 feet 2½ inches)—was quite permissible, provided no further complications were present.

The changes which have been noticed subsequent to the removal of great lengths of the small intestine are fairly constant. The appetite is always greatly increased; the patients eat far more than they have ever done before. Diarrhœa is a constant feature for long periods, and though it can be controlled to a certain degree by careful supervision of the diet, it is apt to occur on the smallest provocation; a milk diet seems particularly likely to excite irritation. In a few cases (*e. g.*, Pauchet's, in which 400 cm. were removed and only 125 cm. remained) the diarrhœa has led to gradually increasing inanition and death. In a few cases the patients have gained weight.

There have been very few investigations into the metabolic changes in these cases. The only recorded cases are those of Frantino (Riva-Rocci), Ruggi (Sabina), Schlatter (Plaut), Lexer (Albu), and especially by Zusch ("Deut. med. Woch.," 1909, p. 739), Miyaki (Onodera and Jano), Nigrisoli (Vitali), Zeidler (Spassokukozkaja), Axhausen (Brugsch), Flint (Underhill), Brenner (Denk). They shew that absorption of fat and of nitrogenous foods is considerably lessened at first, but that this may be compensated for by an increased intake and by careful regulation of the food-stuffs. Emaciation is common at the first, and is due to the rapid passage of food, from which little absorption has taken place, through the intestine. But when a very large amount of judiciously selected food is taken the weight of the patient gradually increases.

The outcome of a study of those recorded cases would seem to shew that a removal of two-thirds of the small intestine may

be performed in the human being without serious risk to life. The remaining third is adequate to fulfil all the functions necessary to the maintenance of life, provided that it is healthy and that care is taken in the selection of the diet.

The surgeon who is suddenly face to face with a case requiring an extensive intestinal resection usually has no choice as to what has to be done.

A glance through the recorded cases will shew that the bowel involved, either in gangrene or in growth, had instantly to be sacrificed if the patient's life was to be saved. In nearly every case death would have resulted had the resection not been performed. To be niggardly in the removal of gangrenous intestine is to detract enormously from a patient's chances of recovery, for in such cases an anastomosis, to succeed, must be made between healthy, viable ends of intestine. The cases quoted in the table shew clearly enough that the most extravagant sacrifice of intestine may safely be made when an imperative necessity for doing so has arisen. The most extensive resection ever carried out on a human being was performed by Brenner; 540 cm. of the ileum were removed from a woman aged sixty-one, for gangrene due to torsion of the intestine in a large femoral hernia. The patient made an excellent recovery, and shewed but little disturbance of her metabolism. She had about five fluid stools a day, which were bad smelling and contained much undigested food. Later conditions improved, and Denk made a test of the functional efficiency of the intestine by Schmidt's method, which indicated a normal digestion. About one and one-half years after the operation Denk repeated the test. At this time she had from three to four soft or fluid stools a day, the latter condition occurring particularly after taking much coffee or milk. Although there was a diminished fat absorption, the patient maintained her weight and was able to do her housework without fatigue. Otherwise the metabolism was perfectly normal.

A subsequent report on this case made by Denk recently shews the importance of a guarded prognosis even in apparently successful cases of extensive resection of the small intestine. A

year after the last report was published, or two and one-half years after the operation, the patient died of marasmus. At the time of operation the patient weighed 48 kilos, and just before death, 26½ kilos. There was a general atrophy of all the organs, particularly of the omentum (Marshall Flint).

The reader who is interested in this subject is referred to an excellent paper by Professor J. M. Flint, "Bull. Johns Hopkins Hospital," 1912, xxiii, p. 127.

SOME INDICATIONS WITH REGARD TO AFTER-TREATMENT IN CASES OF EXTENSIVE INTESTINAL RESECTIONS.

1. The diet should be rich in nitrogen and easily assimilated. Examples, sweetbreads, liver, white meats, sheep-brains, etc.
2. It should not contain too great a percentage of fats, which are badly assimilated in these cases.
3. Carbohydrates in an easily digestible form should be given in increased quantities. Sugar in good quantity, especially powdered glucose.
4. Astringents may be used, and also intestinal antiseptics, as bismuth, in 1-drachm doses, t. d. s., with 10-grain doses of salol.
5. There should be *no* restriction of fluids.

Experimental evidences and metabolic investigations on operation cases shew that:

- (a) There is a decreased digestion of nitrogenous food and consequently nitrogenous starvation.
- (b) There is a decreased digestion of fatty foods.
- (c) Carbohydrate digestion is but slightly interfered with; hence the necessity of a diet largely composed of carbohydrate food.
- (d) Owing to the facts that foods taken arrive at the large intestine in a shorter period, and therefore less adequately digested than is normal, and that they remain for the normal period in the large intestine, there is increased intestinal putrefaction due to the food remaining under these altered conditions, exposed to the action of bacteria in the large intestine. Hence the necessity for intestinal antiseptics.

CONCLUSIONS

These patients should have a rich and easily assimilated diet, poor in fats, and relatively rich in carbohydrates. Bismuth as a colonic antiseptic should be tried with or without salol.

The following table gives all the recorded cases of resection of great lengths of the intestine.

EXTENSIVE INTESTINAL RESECTION.

NO.	OPERATOR AND REFERENCE.	AGE AND SEX.	DIAGNOSIS.	LENGTH OF SECTION OF INTESTINE RE-SECTED.	METHOD OF OPERATION.	RESULT.	INVESTIGATIONS INTO METABOLISM.	AFTER CONDITION, OR CAUSE OF DEATH.
1	Schlatter: "Kor.-Bl. f. Schweiz. Ärzte," 1899. "Beiträge z. klin. Chir.," 1906, xlix, i. "Lancet," 1900, i, 207.	23, M.	Necrosis after punctured wound and intestinal prolapse.	192 cm. after "considerable shrinking" subsequent to removal.	Primary circular suture.	Recovery.	Carried out by Plaut five weeks after operation, residue of nitrogen normal; loss of fat double the average amount.	Seven years later condition good, with light work and careful diet. Tendency to diarrhoea after eating milk, polenta or fruit.
2	Lexer: "Berl. klin. Woch.," 1900, xxxvii, 4. Albu: Berl. klin. Woch., 1901, No. 50.	41, M.	Fibroma of the mesentery, the size of a child's head.	200 cm. small intestine.	Entero-anastomosis. Braun's method.	Recovery.	Carried out by Albu one and one-half	Two years after operation subjective general condition good, with no digestive disturbances
3	Peterson: Ref. Rusch-haupt., Inang. Diss., Bonn, 1901.	?	Slab wound of abdomen. Prolapse of intestine.	202 cm.	?	Recovery.	None. creased by rest.	..
4	Koerberke: "Centralbl. f. Chir.," 1881, viii, 249.	22, F.	Four strictures of the small intestine.	205 cm. small intestine.	Anus preternaturalis, which healed spontaneously.	Recovery.	None.	No digestive troubles.
5	Enderlen: Ref. Lauenstein: "Deutsche Zeitschr. f. Chir.," 1900, c, 169.		Strangulated hernia.	207 cm.	..	Recovery.	..	..
6	Kocher, quoted by Treubicky. "Arch. f. klin. Chir.," 1894, xiviii.	? M.	Traumatic rupture of intestine.	208 cm. small intestine.	Primary circular suture.	Recovery.	None.	General condition good. Slight diarrhoea after carelessness in diet.
7	Mikulicz: Rothe, "Beiträge z. klin. Chir.," 1902, xxxiii, 140.	..	Hernia, gangrene.	215 cm.	..	Recovery.	None.	..
8	Dresemann: Berl. klin. Woch., 1899, xxxvi, 337.	37, W.	Incarcerated femoral hernia, intestinal gangrene following torsion.	215 cm. ileum.	Primary circular suture.	Recovery.	None.	Half-year later general condition good, but twice daily evacuation of pulpy faeces.

EXTENSIVE INTESTINAL RESECTION.—(Continued.)

No	OPERATOR AND REFERENCE.	AGE AND SEX.	DIAGNOSIS.	LENGTH OF SECTION OF INTESTINE RE-SECTED.	METHOD OF OPERATION.	RESULT.	INVESTIGATION
9	Axhausen. "Mitth. a. d. Grenzgeb. d. Med. u. Chir.," 1909, xxi, 55	..	Tuberculous stricture of intestine.	215 cm.	..	Recovery.	None.
10	Karlow. "Hygiea," No. 3.	? M.	Gangrene in consequence of double strangulation by omental band.	215 cm. small intestine.	Primary circular suture.	Recovery.	None.
11	Thon. "Deutsche med. Wchnschr.," 1909, xxxv, 742.	..	Ileus.	220 cm.	..	Recovery.	None.
12	Dekonski. Ref. Istomin. "Russ. med. Rundschau," 1910, viii, 329.	..	..	220 cm.	..	Recovery.	None.
13	Kouwer. "Nederl. Tijdschr. v. Genesek.," Amsterdam, 1898, 2 R. xxxiv, d. 2, 887.	..	Hernia, gangrene.	224 cm.	..	Recovery.	None.
14	Shepherd. "Central f. Chir.," 1898, xxv, 397.	28 M.	Myxofibroma of the mesentery (?).	234 cm. ileum.	Primary circular suture.	Recovery.	None.
15	Kukula. "Arch. f. klin. Chir.," 1900, lx, 887.	38 F.	Tumour of the mesentery.	237 cm. ileum.	Primary circular suture.	Recovery.	None.
16	Harris. "N. Y. Med. Rec.," 1902, 566, lxi.	33 M.	Intestinal gangrene, adhesion of fundulus.	239 cm. ileum.	Ileocolic anastomosis with Murphy button.	Recovery.	None.
17	Hayes, quoted by Harris.	?	Rupture of mesentery, with intestinal constriction.	248 cm. small intestine.	Not stated.	Recovery.	None.
18	Brenner and Denk. "Wien. klin. Wchnschr.," 1907, xx, 1649.	..	Intussusception from polyp.	250 cm.	..	Recovery.	No dissection.

19	Enochlin: Ref. I. - tomin, "Russ. med. Rund- schau," 1910, viii, 329.	..	..	250 cm.	..	..	Recovery.	None.	..
20	Peck, quoted by Harris.	F.	Rupture of the uterus with protrusion of the intestine.	251 cm. small intes- tine.	Not stated.	..	Recovery.	None.	No details.
21	Blayney: "Brit. Med. Jour.," 1901, ii, 1456.	10, M	Rupture of intestine and rent in the mes- entery.	255 cm.	End-to-end anastomo- sis with Murphy but- ton and a few Lem- bert sutures.	..	Recovery.	None.	..
22	Lauwers: "Ann. de la Soc. de Chir. (de Belge)." 1901, ix	65, F.	Ventral hernia, intes- tinal obstruction with adhesions.	265 cm. small intes- tine.	Not stated.	..	Recovery.	None.	..
23	Park: "Arch. In- ter. de Chir.," I. "Centrabl. f. Chir.," 1903, xxi, 55, and "Buffalo Med. Jour.," 1903	24, M	Gangrene of neigh- bouring intestinal loops in appendicitis.	265 cm. small intes- tine.	Lateral entero-anas- tomosis between ileum and cecum with Murphy button	..	Recovery.	None.	Intestinal fistula healed when the Murphy button came away four months later.
24	Payr: "Arch. f. klin. Chir.," 1902, lxvii, 181.	39, M.	Strangulation, ob- struction.	265 cm. ileum.	Primary circular su- ture.	..	Recovery.	None.	Good health eight months later; taking ordinary peasant food, with normal digestion and de- fecation.
25	Pokotilo: "Chir- urgia," 1909, xxv, 169	..	Strangulated hernia.	270 cm.	..	..	Recovery.	..	..
26	Konfstein: "Re- -	..	Tuberculous stricture of intestine.	275 cm.	..	..	Recovery.	..	..
27	Kukula: "Archiv f. klin. Chir."	33, W.	Carcinoma of the ce- cum with metastasis in the mesocolon and mesentery.	284 cm. ileum and 8 cm. colon.	Artificial anus	..	Recovery.	None.	11- 1- 12 were found in the pelvis. Recovered and went home after operation. Some looseness of stools. Gradually lost weight and became marasmic.
28	Childe: "Brit. Med. Jour.," 1901, ii, 891. "Practitioner," 1909, cxxii, 364.	59, F.	Hernia gangrene.	289 cm.	Both ends closed. Lateral anastomosis by suture.	..	Recovered. Lived seven months.	None.	..
29	Lorenz: "Wien. klin. Wchnschr.," 1906, xix, 610.	..	..	292.	..	..	Recovery.	..	..

EXTENSIVE INTESTINAL RESECTION—(Continued.)

No.	Operator and Reference.	Age and Sex.	Diagnosis.	Length of Section of Intestine Resected.	Method of Operation.	Result.	Investigations into Metabolism.	After Condition, or Cause of Death.
30	Goebell: "Deut. Zeits. f. Chir." 1905, lxx, 608.	30.M.	Volvulus, two loops were twisted round one another and were adherent. "Com-pound" volvulus.	300 cm. small intestine.	Lateral entero-anastomosis between ileum and cæcum.	Recovery.	None.	Ten and one-half months later general health good and normal power of work; ordinary food; defecation 1, 2, and 3 times daily. In 1910 quite well and fully able to work.
31	E. Staehlin: "Annals of Surgery," 1907, xlv, 49, and personal communication.	47.M.	Strangulation in old irreducible inguinal hernia, gangrene.	305 cm.	Resection and end-to-end anastomosis by suture. At end of ten days fecal fistula which closed in nine days.	Recovery.	None.	Eats same kind of food but "half as much again as before"; stools formed and soft; one or sometimes two actions daily. Heaviest weight before operation, 158 pounds; now, 146 pounds. He says: "I am just as well as ever in my life."
32	Fantino: "Gaz. Medica di Torino," 1896, xlvii.	60.M.	Large inguinal hernia, with volvulus of intestine and gangrene.	310 cm. ileum.	Lateral entero-anastomosis.	Recovery.	By Riva-Rocci eighteen days later waste of fat (23 per cent.) and nitrogen (20 per cent.) very great. Increased defecation, but no emaciation, on account of increased nourishment.	General condition good a year later.
33	Monprofit: "Rev. de Chir.," 1899, xx, 579.	42.M.	Large inguinal hernia with adhesions of contents.	310 cm. intestine (230 cm. ileum, 80 cm. large intestine).	Lateral anastomosis.	Recovery.	None.	General condition good, except for diarrhœa after eating meat; report six years after operation. Marasmus.
34	Ghedini: "Clin. Chir.," Milano, 1905, xliii, 278.	..	Strangulated hernia.	315.	..	Recovered. Lived three and one-half months.	..	..
35	Zusch: "Deut. med. Woch.," 1909, p. 739 (operation in 1896).	40.F.	Ovarian tumour exclusion followed by resection of intestine.	316 cm.	Not stated.	Recovery.	..	After-condition good, but poorly nourished fourteen years later.
36	Zeidler: "Cent. f. Chir.," 1906.	20.M.	Large inguinal hernia with torsion and gangrene of intestine; retention of testicle.	318 cm. ileum.	Lateral anastomosis with Murphy button.	Recovery.	By Spassokukozkaia, two months after operation, showed condition normal in spite of the waste of nitrogen.	General condition good two months later, and reported to be quite well one year later.

37	Whitall; "Ann. Surg.," 1911, civ, 669, and "Am. Surg.," 1913, vol. lviil, No. 5.	23.F. Abortion; perforation ' 320 of uterus.	Both ends closed.	Recovery.	None.	Bowels acted normally once a day. Condition steadily improved, and no apparent disturbance of nutrition. Five months later developed symptoms of tubo-ovarian inflammation, with possibly appendiceal involvement;
38	Morton: Ref. Kelly-Noble, "Abdominal Surg.," Phila., 1908 p. 442.	Myxosarcoma of mesentery.		Recovery.		pneumonia. In May, 1913, she began to have abdominal pains, gastric disturbances, and a vaginal discharge, with rise of temperature. In June, 1913, a supravaginal
39	Miyaki, quoted by Flint; "Johns Hopkins Hosp. Bulletin," May, 1912.	Tuberculous ulcers and adhesions.	326 cm. ileum, 225, colon, 13.	Recovery.	By Onodera and Jano, two months after nitrogen excretion, 29.8 per cent., fat, 31.7 per cent., considered normal by these observers.	At first three stools a day; seven months later one or two formed stools, had gained 9.5 kilos in weight. (Note: Japanese diet rich in carbohydrates.)
40	Ruggi, "Polichinico," 1896, and "Centrbl. f. Chir.," 1896, xliii, 365.	8.M. Three operations, (1) principally ileum.	Lateral anastomosis, followed by resection and end-to-end anastomosis by suture.	Recovery.	By Sagini a year later, fat and nitrogen waste almost normal (three days exam.).	General condition good one year later.

mass of small intestine.

EXTENSIVE INTESTINAL RESECTION.—(Continued.)

No.	OPERATOR AND REFERENCE.	AGE AND SEX.	DIAGNOSIS.	LENGTH OF SECTION OF INTESTINE RE-SECTED.	METHOD OF OPERATION.	RESULT.	INVESTIGATIONS INTO METABOLISM.	AFTER CONDITION, OR CAUSE OF DEATH.
41	McGuire: "Surg. Gyn. and Obst.," January, 1913.	20 M.	Mesenteric thrombosis, gangrene of ileum.	336 cm.	Both ends closed. Lateral anastomosis; excision at base of mesentery.	Recovery.	None.	Much diarrhoea for some weeks. After this patient gained weight and improved in every way; stools reduced to four or five per day at time of report.
42	F. J. Brougham "Surg., Gyn. and Obst.," 1907, v, 782	27 M.	Gangrene of intestine, commencing 2 inches below duodenojejunal flexure, due to thrombosis of mesenteric veins.	345 cm.	Resection and end-to-end anastomosis with Murphy button	Recovery.	None.	Weight before operation, 170 pounds; at time of report, 133½, is having six motions daily.
43	Nicola: "Clin. Chir.," 1910.		Incarcerated umbilical hernia.	350.		Recovery.		
44	Obalinski: "Arch. f. klin. Chir.," 1894, xlviii, 16.	38 M.	Incarcerated inguinal hernia; on opening of the hernial sac, loops black, but not adhesive; then laparotomy, then torsion of almost entire ileum and caecum.	365 cm. ileum and caecum.	Primary circular suture.	Death in twenty-eight hours	None.	Cause of death not noted, but exceedingly probably collapse.
45	Mitchell: "Brit. Med. Jour.," 1902, ii, 975.	59 M.	Irreducible left inguinal hernia with intimate adhesion of coils.	366.	End-to-end anastomosis by suture.	Recovery		Slight diarrhoea for a short time following operation. Continuous drowsiness from first to sixth weeks, eighteen months after operation in usual health.
46	A. Werelius: "Jour. Amer. Med. Assoc.," 1907, xlviii, 945.	20 F.	Prolapse of intestine through vulva, secondary to trauma.	12 feet, 2 inches (365 cm.).	End-to-end with Murphy button.	Recovery; button passed on tenth day.	None	Eight months after operation had gained 31 lb. to me by L... .. The case of intestinal resection you refer to was out of town and returned only a few days ago. I will briefly give her history subsequent to her departure from the hospital. The patient suffered for six weeks from an almost continuous enteritis, which slowly and gradually subsided after the

47	Pauchet: Personal communication, and "Jahresbericht f. Chir.," 1905, xi, 732.	45, M.	Enormous hernia, a part only reducible.	inguinal	400 cm. ileum.	Lateral anastomosis with Murphy button	Recovery.	None.	The last one she nursed herself (uterus contained seven curette punctures). There was no special trouble during pregnancy. For first two months could not drink nor take soups without bowels acting within an hour, solid nourishment taken better, then three motions daily. Eight months after operation admitted to hospital because of diarrhoea. A few months later died of inanition. At autopsy only 125 cm. of small intestine remained.
48	Friedrich. "Med. Klin.," 1904-5, i, 25.				400.		Recovery.		
49	Stolz: "Deut. Med. Woch.," 1909, p. 744.	40, M.	Volvulus with gangrene.	with gangrene.	475 cm.	Murphy button.	Recovery.	None.	

Good condition one year later.

EXTENSIVE INTESTINAL RESECTION.—(Continued.)

NO.	OPERATOR AND REFERENCE.	AGE AND SEX.	DIAGNOSIS.	LENGTH OF SECTION OF INTESTINE RE-SECTED.	METHOD OF OPERATION.	RESULT.	INVESTIGATIONS INTO METABOLISM.	AFTER CONDITION, OR CAUSE OF DEATH.
50	Axhausen. "Mitt a. d. Grenzgeb. d. Med u. Chir.," 1909, xxi, 55.	18, F.	Volvulus with gangrene.	475 cm.	End-to-end.	Recovery.	By Brugsch sixteen days after; 36.5 per cent. of fat; and 34.2 per cent. of nitrogen. Maintained weight during three months.	Death six months later from pulmonary tuberculosis.
51	Storp: "Deut. Zeitg. f. Chir.," 1907, lxxvii, 322	21, M.	Sarcoma of the mesentery.	510 cm small intestine (the entire ileum and part of the jejunum).	Primary circular suture.	Recovery	None. Microscopic examination of stools showed more fat and fatty acid crystals than normal.	Three months later general condition good. 5 kilo increase in weight, normal defecation. Extensive recurrence five months after operation.
52	Nigrisoli. "Atti. del. xvi Congr. Ital de Chir.," 1902.	22, M.	Intestinal obstruction from extensive adhesions.	520 cm small intestine.	Lateral entero-anastomosis, between jejunum and colon, later resection of all the excluded intestine.	Recovery	By Vitali (began	Continued in good condition. Defecation almost normal, though at first the stools were slimy and watery.
53	Ghedini. "Clin. Chir.," Milano,		Strangulated hernia.	524.	Short circuited.	Recovery.	"Slight disturbances."	
54	1910, Heft 1, p. 146.	61, F.	Strangulated crural hernia; gangrenous.	540 cm.	End-to-side anastomosis, with ileostomy above suture line.	Recovery.	Two and one-half months and one and one-half years after operation normal except for slight disturbance of fat absorption.	Ileostomy closed slowly, good recovery for a time, but death occurred two and one-half years later from marasmus.

This series of cases shews clearly enough that the extent of the resection may be very considerable without involving any such serious risk as one might expect. It emphasises the point, upon which stress has already been laid, that a free removal of the bowel should be performed in any case where doubt exists as to its integrity.

In certain cases the band which has caused the constriction has been very narrow and has compressed the gut very tightly. A fine linear band of gangrene is thereby produced. If this band encircles the intestine, a resection operation is not always necessary. The damaged strip may be simply infolded and closed over by a continuous suture which picks up the serous and muscular coats. When the gangrenous part gives way, it will be shed into the lumen of the bowel and the firm line of union ensured by the suture will prevent any leakage into the peritoneal cavity. In some instances a very small patch of gangrene or a perforation may be met with. It is in cases such as these that a partial resection has been successfully performed. The edges of the perforation are trimmed and sutures applied, or the damaged area is inverted. Caird has recorded ("Edin. Med. Jour.," 1895, p. 312) five cases of gangrene or perforation, occurring in strangulated hernia, which were treated by inversion. In some cases of Richter's hernia, with gangrene limited to a very small area opposite the mesenteric attachment, this method may be adopted. But it is to be remembered that the walls of the bowel around the damaged area are infected and but little likely to lend themselves to safe suture or to sound healing. The operation of inversion, though occasionally advisable, is probably not so safe a procedure as resection.

In all operations where the bowel has been strangulated and has become gangrenous the most minute precautions must be taken to avoid contamination of the operation area in the handling of tissues which are infected with swarms of the most virulent organisms.

In some instances the use of an omental flap or graft is of great service in strengthening the line of union.

In both the operations above described the removal of a triangular piece of the mesentery is desirable, for in cases of growth the glands are included in it, and in cases of gangrene, the vessels in the mesentery are seriously damaged, and the veins perhaps filled with septic clots.

In cases of multiple wounds of the intestine or in other rarer conditions the removal of this triangular piece of the mesentery is not necessary. The mesentery quite close to the

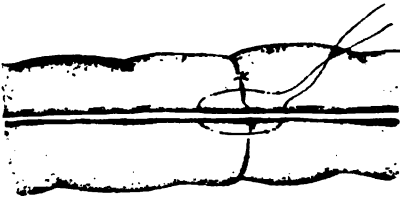


Fig. 216.—Mitchell and Hunter's suture for application at the mesenteric attachment.

bowel may be cut through along a line parallel to the intestine, and the bleeding points clipped and ligated. When the ends of the intestine are stitched, the mesentery can then be folded upon itself in a pleat. It is said that in such a condition the

suture-line at the mesenteric gap is likely to be more securely closed than when the mesentery is removed. Sir William MacCormac also claimed for this method that, since it interfered less with the vessels of the mesentery (the terminal branches only being clipped), gangrene of the bowel was far less likely to occur than when the deeper vessels of the mesentery were ligated. (See Figs. 214 and 215.) It is perhaps desirable to call attention to a very satisfactory stitch, introduced by Mitchell and Hunter, for the purpose of effectively closing the gap at the mesenteric edge. The diagram (Fig. 216) explains itself.

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